Busbar Data for Outdoor Switching Structures—One of a Group of Articles on Station and Operating Practice with the Regular Science, Engineering and Commercial Departments

Electrical World

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For complete information regarding Model 341 Voltmeters write for Bulletin No. 2004. Other models in this group are Model 310 Single-Phase and Direct Current Portable Wattmeter, and Model 329 Portable Polyphase Wattmeter, both described in Bulletin 2002; and Model 370 A.C. and D.C. Portable Ammeter, described in Bulletin 2003.

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Manufacturing Costs Increase

THE influence of high prices of raw materials on manufacturing costs in the electrical industry creates a problem which is felt acutely at the present time. The rapid advances in nearly all raw material costs, the scarcity of some supplies even at the prevailing high level and the mounting costs of labor constitute a combination which has upset the stability of costs in many lines of production. Such conditions have not prevailed in as serious a degree at any previous time in the history of the industry. Where it is possible to do so, many manufacturers have introduced successful economies, with the result of overcoming in part the greater cost of their basic materials. In most instances, however creditably these efforts have been conceived and executed, they have not offset the full measure of extra cost which is one of the indirect burdens of the European war. While efforts of this nature will be continued, the large advances in cost during the last year and the still strong and uncontrollable tendency toward further increases mean readjustments in prices.

Public Interest in Engineering

IT is a pity that it is so universally believed that the public is not interested in matters of engineering. The technical side of the central-station development, for instance, is seldom presented to the public view. No one of us can feel enthusiasm for a thing we fail to comprehend; but there is nothing more appealing to every American man and woman than plain, straightforward stories of creative achievement, and surely there is good material for such stories in the work of central-station engineers and operators. The ear of the householder may not be attuned to enjoy the murmurings of the slide rule, but the details of a night's struggle with a sleet storm for public service is a subject that arouses us all. Stories of engineering accomplishment and descriptions that tell how "the wheels go 'round" are universally appealing. Invite the editors of your local newspapers and a few of your prominent customers, occasionally, to make an inspection tour with you. Show them all about the plant. Explain the principle of your distribution system. Tell them stories of the work that is done in times of storm, the problems of the winter peak, of load dispatching. It will bring you interesting evidence that, after all, the trouble has been more that you have failed to talk than that the people have not listened. And the more this service that you render is understood by your neighbors the stronger will be the bond between you.

The International Mission

THE reader of the article by Charles A. Stone which appeared in last week's issue cannot fail to realize that America is in the presence of a great opportunity. This country cannot grasp the opportunity without taking upon itself at the same time the heavy responsibilities that are joined with tremendous power. Both opportunity and responsibility belong in large measure to the electrical industry. Now, it is the duty of the industry to see that substance is not wasted, that capital is conserved, that this country shall be prepared to render an international commercial service whose importance was never before known. It is natural that in writing for the ELECTRICAL WORLD Mr. Stone should direct particular attention to the promise which the organization of the American International Corporation holds for this industry. His connection with the industry is too close for that vital part of his life to be lost in the background. But Mr. Stone and those of his colleagues in the new movement who also have large electrical interests cannot do for the industry what the industry can do for itself. To become international in hopes and accomplishments the industry must be ready to give instant co-operation, to take the initiative, to accept the chances that will mean success.

The Pan-American Scientific Congress

"ONE for all and all for one" became the keynote of the second Pan-American Scientific Congress, closed this week, following the address of Secretary of State Lansing. While scores of papers in a most catholic program were excellent, the spirit of the conference, reflecting as it did the world influences of the present time, is probably best characterized as political rather than scientific or engineering. So important is the promotion of a sympathetic understanding of our mutual problems in the Western Hemisphere, however, that the stabilizing influence engendered at this gathering of representative men may underlie not only scientific and engineering development of future meetings but many larger problems of state. As is so often the case, many detail questions are eliminated if an understanding of the basic principles is expressed and mutual confidence established. Delegates are agreed that this bond of understanding between nations was cemented more closely by the two weeks' interchange of ideas on scientific and economic questions of the day. While the sincerity of the motives that prompt a desire for closer co-operation has been established, unfortunately that cannot of itself initiate action. Or-

ganization for definite purpose is needed to translate good feeling into results. One very definite problem of transacting business between parties whose wants and products respectively are relatively unknown to each other is a question of so standardizing quality that the buyer may be positive that the seller's goods are what he ordered. It has been suggested that commercial laboratories, agreed on between representative organizations or representative individuals in private transactions between the United States and South American states, act as inspectors so that both parties in these long-distance commercial interchanges shall have a recognized authority. This is merely one detail problem out of many that will be solved only by definite organized action, but whose solution is at least made much nearer by the establishment of broadly sympathetic relations which the second Pan-American Congress has forwarded.

The Automobile Show and Its Lessons

THE national automobile show held this week in New York serves to focus attention on the phenomenal growth and magnitude of the automobile industry. Numbered among the youngest of our great enterprises, the sales of gasoline automobiles during the year just closed nevertheless ranged between $625,000,000 and $700,000,000. Exports alone totaled over $100,000,000, chiefly in commercial trucks to two of the warring nations. What a contribution toward keeping business running during the dark period of uncertainty following the outbreak of the war! Amazing as are these figures, they do not tell the whole story. The automobile exercises a certain influence over, and also reacts upon, other industries. We have already alluded in these columns to the menace confronting the electric vehicle in the growing output of gasoline trucks. Apparently the struggle for supremacy has already begun, for last year the production of electric vehicles of all types was less than $15,000,000.

Employees and Commission Work

THE relations of utility companies with public service commissions are so important a part of modern administration that employees in general ought to be better posted about this class of work. It commonly falls upon the executive officers, and occasionally upon department heads, to represent a company in these proceedings at the side of the usual legal counsel. Commission work is properly handled in this way, but it is apparently dropped at this point in perhaps 99 per cent of the cases. Many employees have no more comprehension of the problems their superiors are meeting before regulating bodies than the local sewing circle of the Evangelical Alliance has of the plans of the German general staff for the spring of 1916. Surely some inkling of current commission proceedings affecting a company may profitably be given to interested employees, either through informal talks at company section meetings, by bulletins, or through the company monthly magazine, if such a publication be maintained. Commission proceedings are matters of public record, and yet the rank and file of the employees cannot follow them in person because of other duties. The breadth of modern regulation is such, however, that it affects corporate administration and policies, commercial and technical, in the most minute details of daily operation and service, and organizations striving to train their employees will do well to include local commission work in the subjects presented for study.

The Growth of Electrical Supply in London

THE inaugural address of President Sparks of the Institution of Electrical Engineers is a striking résumé of the growth of electrical supply in England for the last thirty years or more. We in this country have a very limited idea of the peculiar conditions under which the electrical industries have labored in England and the long struggle that has gone on to bring electrical development to a point commensurate with the importance of its necessities. Perhaps nothing is more striking in the whole story of slow advancement than the effect of well-intentioned, perhaps, but nevertheless adverse legislation. Electric lighting had scarcely come upon the field before the trouble began. In England rights have to be obtained by direct act of Parliament. In 1882 an electric-lighting act was passed which choked the industry for years, since Parliament in passing the act at that time decreed that the electric-lighting enterprise should be strictly local. The metropolitan area was divided into no less than forty-two local government areas acting independently. Companies that wished to go into business could obtain only a seven years' license, or at best a provisional order for twenty-one years, with an opportunity for renewals for seven-year periods, the whole undertaking being subject to purchase by the local authority. This was discouraging enough to capital, and in six years only three private companies were put under license in Great Britain for public supply under this act. This was the very period in which electric lighting had a startling growth in our country under more liberal and friendly legislation. An act of Parliament in 1888 doubled the life of the private undertakings and made the terms of compulsory purchase less rigorous, but still left the industry in bad shape. And it was twenty-one years more before really important legislation was secured giving to the British electric-supply companies anything like the rights under which the American industry had flourished. The act of 1909 for the first time gave the right to sell electric energy in bulk, to supply railway undertakings, and to allow the association of supply companies under a common management. The result of all this was that the electrical supply of London was, and has been, cut up into irreconcilable fragments partly under private and partly under public ownership.

We have more than once discussed in these columns the various projects which have been undertaken for

the unification of this heterogeneous collection of stations. Nothing has yet been accomplished by reason of the brakes put upon activity by unsuitable legislation. London, therefore, is supplied now, as it has been for years past, by a group of stations neither co-operating nor possessed of any unified policy, part of them purely private and part of them conducted under public authority. That they have done as important and extensive work as they in fact have speaks volumes for the skill, energy and efficiency of the British engineers and managers who have had the work in charge. In spite of adverse conditions, many of the enterprises have been conducted with remarkable success, although a vastly greater measure of growth would have been achieved had there been any opportunity for carefully ordered general supply. Whether this can be worked out in the near future remains to be seen. The situation is so mixed and the investment in separate undertakings so great, owing to the universal use of underground distribution, that it is a very difficult matter to gain unity.

Any comprehensive scheme, as President Sparks points out, must involve the whole overhead charges due to a new high-pressure network and to the complete conversion plant for utilizing the new distribution. A new network must deal with individual areas which are now supplied by alternating current at eighty-three, sixty. fifty, forty-five and twenty-five cycles, together with constant current supply at two or three different pressures. The alternating-current distributions are single-phase, two-phase and three-phase, at pressures running from 10,000 volts down to 2000 volts. If any worse combination of heterogeneous elements could well be imagined, it would be hard to specify it. In spite of all these difficulties, there has been profound study of the opportunities for economy, and there is at least a possibility of the finally successful achievement of the apparently impossible. The whole situation should serve as a most impressive lesson regarding the effects of short-sighted legislation in discouraging initiative. American central stations have their own difficulties to contend with, some of them serious ones, but in no great city has so desperate a situation from the economical standpoint been faced. It is remarkable evidence of personal efficiency that, in spite of these difficulties, the great British metropolis should be as well supplied as it is from the standpoint of the consumer. A retrospect of this sort by an engineer who has been in service through the whole development of the art is particularly valuable in giving an epitomized view of such an intricate and at the same time instructive situation.

Outdoor Substation Structures

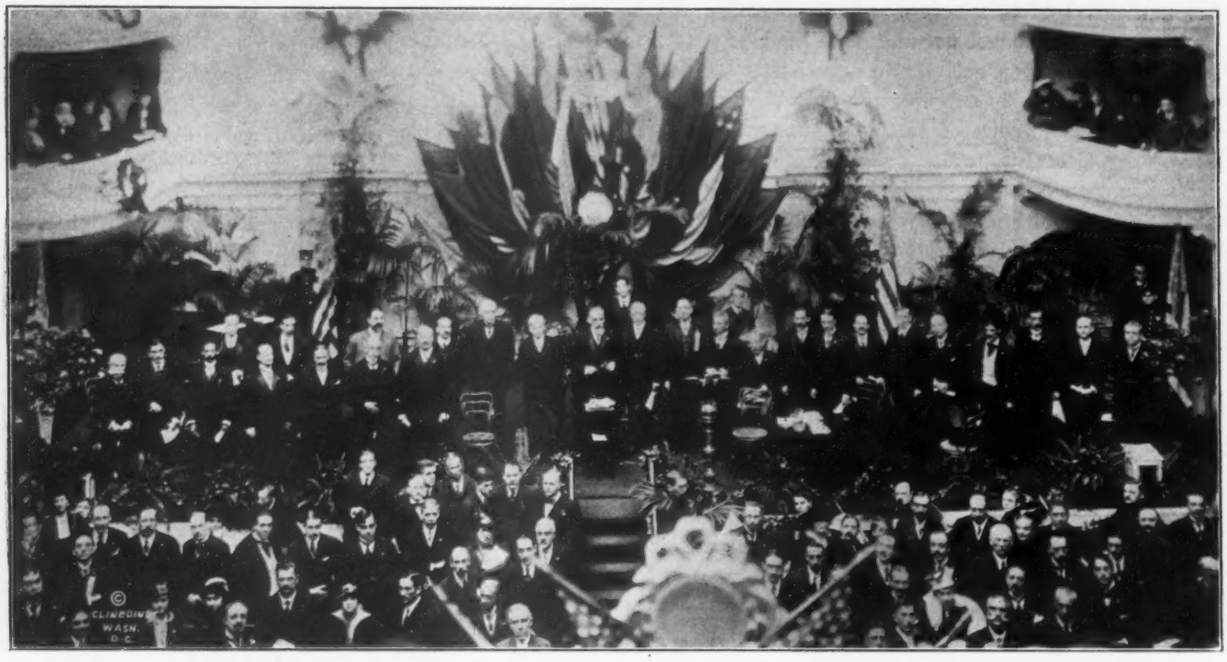
A VERY useful illustration of the serious thought now being given to the development of outdoor substations and switching stations is given in the comparison of various materials and sections for busbars and in the tabulation of the electrical and physical characteristics of such members elsewhere in this issue. Outdoor substation construction of this nature has perhaps been more generally used in the South, but it is rapidly growing in importance in the North as well. The number of stations for any one company, in northern climates at least, is as yet limited, and this in a measure explains the lack of standardization or of comparative-cost analysis.

In regions subject to heavy snow and sleet loads it seems probable that long busbar beams should be designed to carry such loads in addition to their own weight. The suggested factor of safety of five is rather higher than is common in transmission lines or even in building construction. On the other hand, the ultimate strength values cannot be closely approached without deformation or buckling. If, for example, medium steel members are used, with an ultimate strength in tension (bending) of 80,000 lb. per square inch, the elastic limit of such material would probably not exceed 48,000 lb. per square inch. Moreover, 80,000 lb. is rather excessive for ordinary commercial steel shapes, the standard material more nearly approaching 64,000 lb. In columns and struts the limitation of the ratio of slenderness is always advisable, as indicated by the compression formula of $19{,}000 - 100\,L/B$. This value, L/R, acts to decrease the allowable unit stress of long, slender members. In fact, and assuming medium shapes, the allowable unit stress for a ratio of 100 would be the average formula of 7000 lb. per square inch. This value in ordinary cases would represent a factor of safety of about three.

Apart from the question of the comparative estimated cost of the two materials and sections between which a decision is to be made for any particular case, it will be a great advantage to adapt the design to the capabilities and the tools of the small line crew. It is possible that many more installations, some perhaps temporary, would be built were a suitable design more generally known. It is a fact that in various places around the country there are home-made pipe frames forming outdoor switching and transformer stations that are entirely adequate and economical, but unfortunately unknown beyond a very limited area.

The Coming Issues

FOLLOWING the usual plan, next week's ELECTRICAL WORLD, the third issue for the month, will be the engineering and technical number for January, with articles on the engineering design of the electrical features of the new Equitable Building, New York City, the largest office structure ever built, and the layout and installation of station busbar construction. With this issue of Jan. 15 there will also be begun a series of articles on "Opportunities for Electrical Engineering Graduates," to appear regularly in the third or engineering number of each month. In the commercial number of the following week, dated Jan. 22, there will be presented a group of articles bearing on sales campaigns and methods for extending the use of electrical service, with a special contribution detailing actual experience, under various conditions, and a method of retailing electrical service among the humbler homes and poorer business houses which heretofore have generally been considered barren ground.



The Pan-American Scientific Congress, Whose Two-Week Session at Washington Closes To-day

At the center of the platform, gavel in hand, is the presiding officer of the Pan-American Scientific Congress, the Chilean Ambassador to the United States, Dr. Eduardo Suarez Mujica. At his right stand Secretary of State Lansing, John Barrett, director-general of the Bureau of American Republics, and the chairman of the Brazilian delegation, Domicio da Gama. Seated is Señor Don Ignacio Calderon, chairman of the Bolivian delegation. Thomas R. Marshall, Vice-president of the United States, stands at Chairman Suarez' right. Others on the platform include the representatives of Peru, Ecuador, Guatemala, Panama, Argentine, and other South American republics.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

Date Set for N. E. L. A. Convention

It has been officially announced that the next convention of the National Electric Light Association will be held in Chicago during the week of May 22. The headquarters will be at the Congress and Auditorium hotels, where it is proposed that all the meetings shall be held as well as the usual exhibit by manufacturers of electrical apparatus. At one time it was thought to hold the convention in Chicago during the early part of June so as to enable delegates to take advantage of the reduced railroad fares which usually go into effect on June 1. When the plans were about ready the Republican party decided to hold its convention to nominate candidates for President and Vice-president in the same city and at the same time. This upset the plans of President Lloyd, and after thoroughly canvassing the situation the date noted above was decided on.

To Form New Sections of Associated Manufacturers of Electrical Supplies

There will be a meeting on Jan. 12, 1916, at 11 a. m., at the Hotel Biltmore, New York, of the manufacturers of outlet boxes, conduit boxes, covers and accessories for the purpose of forming a section of the Associated Manufacturers of Electrical Supplies. Invitations have been sent out to a large number of manufacturers in this line, and it is believed the meeting will be of considerable importance to the trade. In the afternoon, at 1 o'clock, the manufacturers of porcelain products will also meet to consider the formation of a section of the Associated Manufacturers of Electrical Supplies. This meeting has been called at the request of a number of manufacturers in this line, and great interest is being shown in the formation of the section.

At the meeting of the molded or formed insulations section to be held later in the afternoon, at 3 o'clock, the question of forming a separate section for the manufacturers of vulcanized fiber will be considered, and also the appointment of standing committees.

New York City Discards the Arc Lamp for Street Lighting

All arc lamps in the city of New York are to be replaced with large-sized gas-filled tungsten units under the terms of the contracts entered into for 1916 with the different lighting companies supplying the city. Bids for supplying different parts of the city have been accepted from the New York Edison Company, the United Electric Light & Power Company, the Bronx Gas & Electric Company, the Westchester Lighting Company, the Edison Electric Illuminating Company of Brooklyn, the Flatbush Gas Company, the New York & Queens Electric Light & Power Company, the Queensboro Gas & Electric Company and the Richmond Light & Railroad Company. The amount of money which the

city is authorized to spend for the lighting of streets, parks and public places for 1916 is $3,022,543, divided as follows among the different boroughs: Manhattan and the Bronx, $1,285,782; Brooklyn, $1,075,685; Queens, $493,076, and Richmond, $168,000.

The new gas-filled units will range from 100 cp. to 400 watts in size, and the vacuum type of lamps from 40 watts to 100 watts.

During the year 1914 the city discontinued the use of the flaming-arc lamp. Beginning with 1915 there were in service 18,211 arc lamps, many of which during the year were replaced with gas-filled tungsten incandescent units. In 1916 the remainder of the arc lamps will be replaced.

The prices which the city will pay for the new incandescent units will mean a saving in the larger sizes of approximately $10 per lamp over the arc lamps they will replace.

Besides the saving to the city in dollars and cents, it was found after a careful investigation and comparison of the gas-filled tungsten units with the arc lamps that the gas-filled unit afforded a more uniform distribution of light, without glare or flicker, and has a much greater penetrating power in stormy or foggy weather.

Annual Meeting of the American Physical Society

The annual meeting of the American Physical Society with Section B of the American Association for the Advancement of Science was held at Columbus, Ohio, Dec. 27-30, 1915. The local headquarters for the American Physical Society were at the Virginia Hotel, and the headquarters for the American Association for the Advancement of Science were at the Hotel Chittenden. All sections of the societies met at the Ohio State University. Some sixty-two papers were presented, about half of which were electrical in their nature.

Million-Dollar Contract for New Steel-Mill Electrical Equipment at Indiana Harbor

The Inland Steel Company of Indiana Harbor, Ind., has just placed with the Westinghouse Electric & Manufacturing Company an order for the power and electrical equipment for an entire new mill at its Indiana Harbor plant. The contract price, which is authoritatively stated to be about $1,000,000, represents one of the largest single orders for steel-mill electrical machinery ever placed. Two 5000-kw. turbine-alternator sets and auxiliary apparatus, two flywheel motor-generator sets, two 8000-hp. motors and one 15,000-hp. motor are included in the equipment specified.

Close of Pan-American Scientific Congress

The second Pan-American Scientific Congress will come to an end in Washington Saturday, after sessions which have lasted two weeks and which were participated in by delegates officially sent to Washington by the governments of twenty American republics in addition to those of the United States. The first congress was held in Santiago, Chile, in 1908, and the second one was held in Washington because of the changed conditions brought about by the war in Europe and the desire thus caused for closer co-operation between the American republics which was given its first official impetus at the Pan-American Financial Conference held in Washington last May.

While many of the newspapers of the country in their reports of the proceedings of the second Pan-American Scientific Congress have paid principal attention to the political aspect of the congress and its object of drawing the American republics closer in spirit as a result of the war, and to the hope of a trade stimulation between the countries of this hemisphere as another result, the fact is that many questions of scientific interest were taken up by the delegates to the congress, in engineering, electrical, metallurgical, chemical and transportation fields. The foremost men in South and Central America were sent to Washington by their respective governments to discuss these questions with men equally prominent in these lines in the United States, and in addition a number of unofficial delegates from Latin America attended.

The most elaborate entertaining in the history of Washington took place in honor of the Latin-Americans, a unique feature of this entertaining being a series of dinner parties at the private homes of Washington given by women who desired to be of patriotic service to the country. There were thirty-five of such dinners, as well as a number of public banquets and receptions, etc., among the latter being a state entertainment at the Pan-American Union building, with the United States government as host, which was more ceremonious and on a greater scale of splendor than any entertainment ever before given in Washington. In addition, President Wilson gave a reception at the White House Friday night which took the place this year of the "diplomatic reception" of previous years at the White House, and the President also addressed the congress at the Pan-American Union building Thursday night.

The work of the congress was organized in sections, there being nine of these groups. They met in various Washington hotel and other auditoriums, including the new National Museum, the Carnegie Endowment Building, the Pan-American Building and other places, and the section meetings continued simultaneously. The United States government appropriated $85,000 for the expense of the congress, and each of the governments of other countries appropriated a large sum, the Argentine delegation having been allowed $90,000 for its expenses. Fifteen national and international societies also held conventions in Washington in connection with the congress, meeting in joint session with the sections of the congress in whose work the organizations were particularly interested.

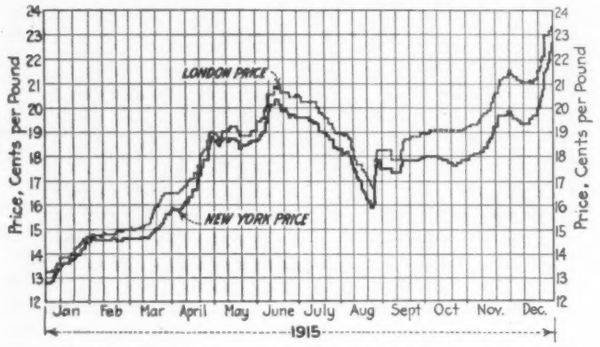
Questions of interest to the electrical industry were taken up in Section III, devoted to the conservation of natural resources, of which Dr. George M. Rommel of the United States Department of Agriculture was chairman, and in Section IV, devoted to engineering, of which Brig.-Gen. W. H. Bixby, U. S. A., retired, was chairman. Questions of interest to the metallurgical and chemical industries were also taken up in Section III and Section IV, and in Section VII, devoted to mining, metallurgy, economic geology and applied chemistry, of which Hennen Jennings, former president of the London Institute of Mining and Metallurgy, was chairman. Questions of interest to the electric-railway field were taken up in Section IX, devoted to transportation, commerce, finance and taxation, of which Dr. Leo S. Rowe of the University of Pennsylvania was chairman.

John Barrett, director-general of the Pan-American Union and secretary-general of the congress, was the moving spirit of the congress, although William Phillips, Third Assistant Secretary of State, was chairman of the executive committee, having associated with him a number of other prominent men. Dr. Suarez Mujica, Ambassador of Chile to the United States, was president of the congress.

Higher Prices for Electrical Materials

Unprecedented Rise in Costs of Raw Materials and Labor Increases Expense of Manufacturing Electrical Apparatus and Supplies and Leads to Advances in Prices

Higher costs of materials have brought serious problems to manufacturers in the electrical industry. Accompanied, as they are in many cases, by higher wages for labor, they mean a radical revision in the cost of manufacturing for nearly all classes of machinery and supplies. Already the inevitable resultant effect of higher costs is apparent in advances in prices in various branches of the industry. And with the present tendencies in the prices of basic materials and labor, further advances in the quotations for the finished products in many lines appear to be certain.



ELECTROLYTIC COPPER HAS NEARLY DOUBLED IN PRICE

The unprecedented advances in values of raw materials, which are the responsible cause of higher prices for finished products, result from a war which calls for a consumption of metals on a scale that is without parallel in history. And substantially all of the metals that are used in the manufacture of munitions of war are those that are necessary for electrical manufacturers. Probably the electrical industry is suffering more than any other industry from the shortage and high prices of its raw materials as a result of the tremendous demand for munitions of war regardless of cost.

Copper in the Industry

The most conspicuous metal whose use is indispensable in the electrical industry is copper, and the fluctuations in this market have caused changes of great importance in values. Since the publication of the article on the copper situation in the ELECTRICAL WORLD of Nov. 6, 1915, the price of the red metal has increased still further. It has gone from about 18 cents to 23 cents per pound, and large recent orders from the Allied governments in Europe have absorbed consumption capacity still more closely and stimulated copper producers to look forward to even greater demands and higher prices in the future.

Admitting that the time of conclusion of the war, and hence the end of the demand for war purposes, will mean a sudden readjustment of the bases of their market, some of the copper authorities still express confidence that an equally insistent demand for peaceful industrial uses will follow immediately. They point to the known sacrificing and stripping of all supplies of copper in Germany and the countries allied with it in the war, to the entire destruction of thousands of industrial plants, and to the expected large demand in this country. They do not fear industrial collapse so much as they hope for an industrial revival throughout the world after the settlement of peace.

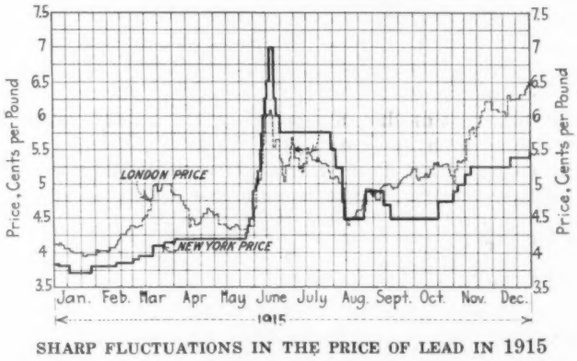
New Price Level in Copper

The latest changes in the prices of copper, carrying it far above the level of 18 cents, at which central-station buying is generally curtailed, have contributed heavily to the present problems of the electrical manufacturers. This will be appreciated by reference to a rough estimate of the effect. If an increase of 1 cent per pound in the cost of copper means an increase of, say, 1 per cent in the cost of some types of apparatus, a rise of 8 cents, or from a normal price of 15 cents to 23 cents, means an advance of 8 per cent. If for every increase of 1 cent in the price of copper per pound there is a corresponding increase of 2 per cent in the manufacturing cost of other classes of electrical products the same advance in the copper market would create a change of 16 per cent to be taken into account.

The copper situation in the electrical industry is also affected, however slightly, by the use of this metal as a substitute for other metals which are unobtainable because of the demands for war munitions. For instance, the difficulty of obtaining brass from the makers at assured dates or at terms corresponding to those prevailing in normal times has led some manufacturers to substitute copper for certain purposes. The action of some central-station companies in various parts of the country in replacing aluminum transmission wires with copper and making a profit by the sale of the scrap aluminum was illustrated by the example of the Rochester Railway & Light Company, which was reported in the ELECTRICAL WORLD of Dec. 25, 1915.

Other Advances

Outside of the prominent instance of copper substantially all other metals have risen in price and thus have advanced manufacturing costs. In commenting on the situation to the representative of the ELECTRICAL WORLD, manufacturers refer to the higher prices of, for instance, steel, lead, aluminum, spelter, machine tools, and, more recently, rubber. In addition, there is the great difficulty of getting deliveries promptly, and this frequently bears directly upon the price. To be told by a machine-tool maker that delivery will be made when it is possible to make it, and that the price will be the current market quotation at the time of delivery, does not give the electrical manufacturer any definite groundwork for his calculation of costs or promise of delivery in dealing with his customers. Nor does it clear the atmosphere to find, after the acceptance of a contract, that an unexpected double price must be paid for prompt delivery of some of the materials which are essential



SHARP FLUCTUATIONS IN THE PRICE OF LEAD IN 1915

for the finished product. Yet those are typical of the experiences that electrical manufacturers are having. To the difficulties of price increase are added the difficulties of delayed or uncertain delivery of materials or goods which are needed for the finished apparatus.

The accompanying table, taken from the records of one manufacturer, gives an approximate idea of the difference between values for raw material based upon market conditions of Jan. 1, 1915, and market conditions of Jan. 1, 1916. In the individual articles an arbitrary value was taken in order to show the relations between the two periods, as it is impossible to represent actual value of different classes, weights and types of cast iron, for instance, in any one figure, and that is true of other materials.

RAW-MATERIAL PRICES NOW AND A YEAR AGO

	January 1, 1915	January 1, 1916	Increase
Iron castings	3.50 cents per pound	4.00 cents per pound	$10.00 per ton
Steel castings	4.60 cents per pound	5.40 cents per pound	$14.00 per ton
Steel shafting	1.70 cents per pound	3.50 cents per pound	100 per cent
Sheet steel at mill	2.40 cents per pound	2.90 cents per pound	$10.00 per ton
Steel forgings	2.25 cents per pound	3.50 cents per pound	100 per cent
Ingot copper	13 cents per pound	23 cents per pound	10 cents per pound
Wrought brass	13 cents per pound	26 cents per pound	100 per cent
Cast brass	20 cents per pound	30 cents per pound	50 per cent
Cotton tape	50 cents per gross yd.	60 cents per gross yd.	20 per cent
Asbestos tape	$1.00 per pound	$1.25 per pound	25 per cent
Lumber	$20.50 per 1000 bd. ft.	$24.00 per 1000 bd. ft.	$3.50 per 1000 bd. ft
Mica	$1.00 per pound	$1.40 per pound	40 cents per pound

EFFECT ON DIFFERENT CLASSES

The very marked advances in raw materials, of course, affect different classes of goods in different ways. Manufacturers of wires and cables, in which the raw material cost comprises nearly the entire cost and the labor element is slight, are able to follow their regular practice of substituting new price lists for the old ones with every substantial change in the market. Another class of apparatus is that which through a long period has been somewhat standardized as to price. In such a class the manufacturer who, notwithstanding the higher level of raw materials, hesitates to make advances to his customers faces the alternatives of, on the one hand, cutting his costs by economies or through larger production or, on the other hand, losing or lessening his profit. Then there is another class, comprising the apparatus which is manufactured on individual orders. Not being subject to predetermination for the purposes of a price list and being in a competitive field, the costs in this class of apparatus necessarily change with fluctuations in material costs.

As the proportions of labor and material costs vary so greatly in different classes of materials, it is not possible to state how much effect each of these factors will have on changes in prices. In some well-known cases the cost of labor represents about 70 per cent of the total cost of the finished product. In other cases, of course, the inverse proportion holds true. But, as in the case of raw materials the electrical manufacturers suffered because of the demand for war munitions, so have they felt in a similar way the results of the demand for labor for this purpose.

PRODUCTION ECONOMIES

In the effort to keep costs from mounting in the same ratio as the mounting costs of raw materials, many economies in production have been instituted. In some cases these have been sufficient to overcome the added costs of raw materials, so that in such instances the manufacturers concerned do not at this time expect to make increases in prices to consumers. In other cases, however, comprising a wider range of classes of apparatus and supplies, the discussions of officials of the manufacturing companies with a representative of the ELECTRICAL WORLD show that the costs of materials have gone beyond control. In one manufacturing company a record of the quotations of materials comprising over 80 per cent of the raw materials used shows that present prices are 35 per cent higher than the average prices prevailing during 1915.

With such a condition the manufacturers take the position that the only course which will prevent disaster is some increase in prices. The higher costs of materials are already reflected by advances in prices, and others are expected to follow, even if the present level of raw materials remains unchanged, and still greater advances are predicted if the costs of raw materials should be subjected to more intense demands with consequent higher price levels. The causes of higher costs are clear in the quotations in all markets for raw materials, but the effects have been slower in making their appearance.

APPROXIMATE INCREASES

As the materials manufactured by many of the electrical manufacturing organizations are so diversified, it is not possible to estimate except as a frank approximation the probable extent of the increases in prices. In such classes as wires and cables, where the price is dependent largely on the price of the copper metal, the increase already has been very sharp, and only a little further increase in the market is necessary to make the advance from the low point a round 100 per cent. This, of course, is not characteristic, but it is a positive index of some of the undeniable higher costs. Conservative judges estimate the increased cost of manufacturing in general, as a result of the conditions produced by the war, at not less than 15 or 20 per cent. In certain lines of materials it is not believed that an increase of more than 10 per cent will be required in order to cover the advance in cost.

Manufacturers who keep exact records of their costs realize the full extent of the problem created for them by the changes in the markets for raw materials. Not all of the manufacturers, however, make a careful study of their production costs.

Dr. Francis B. Crocker, who has devoted much study to the subject of costs of electrical manufacturing in his connection with the Crocker-Wheeler Company, was asked to express his views to the ELECTRICAL WORLD on present conditions. He discussed the crude, inadequate methods of cost-keeping in the early days of the industry and attributed many of the difficulties of the present situation to those and to the inherent problems in electrical energy.

VIEWS OF DR. CROCKER

Dr. Crocker declared that extreme cheapness is a very questionable virtue in electrical apparatus, just as cheap dental work is poor economy. The contingencies and troubles that may arise are more numerous and complicated than in any other branch of business. In its design, construction and operation every electrical machine involves difficult questions in four branches of science—electricity, magnetism, mechanics, and heat. Very often these are mixed up in most puzzling confusion. With electrical apparatus the slightest defect in the insulation, such as a pinhole or a hardly visible chip of metal, is likely to start serious trouble and often results in a burn-out of the whole machine or a vital part, involving costly delays and repairs. A break or a cross-connection at any point in the windings, which usually contain hundreds or thousands of feet of wire, may have similarly disastrous effects.

In spite of these undeniable facts, added Dr. Crocker, electrical machinery, including generators, motors and transformers, has been sold on the average with less

percentage of profit—that is, nearer to actual cost—than almost any other manufactured product. Nearly everyone in the business of selling goods makes similar claims and complains of the small margin of profit in his particular trade. In general, this is merely the natural human desire to sell at as high a price as possible. In the case of electrical machinery, however, there are a number of special reasons that have really had the effect of making the average selling price abnormally close to the cost. Some of these reasons are:

ERRONEOUS COST-KEEPING

First—It is a new business for everyone, and new people are continually coming into it so that there is a great tendency to omit items of cost, which are brought out only by experience. In this way the assumed profit is partly or entirely used up.

Second—The foregoing would be true of any new or rapidly growing business. In addition there are the many technical and often highly scientific questions that continually arise in the manufacture and use of electrical apparatus. Even in the case of established lines of machines of which thousands have been made, one particular, individual machine may show peculiar actions that are difficult for the most experienced engineer to explain. Most of this is impossible to foresee, but it increases total cost.

Third—The type of men in business, particularly salesmen, are inclined to seize upon any opportunity and quote very close prices. They are the opposite of the old-fashioned, hard-headed business man, who asks a certain price and sticks to it.

Fourth—The novelty and rapid extension of the electrical business puts each salesman in the position of a pioneer or missionary who is advancing a worthy cause by making a sale even at a low price. This is true, but not profitable. Several experienced salesmen recently took that position about a very successful line of machines that had been on the market for four years.

Fifth—The requirements of electrical machinery differ widely as to size, power, speed, voltage, temperature, open or inclosed, horizontal or vertical, and waterproof construction, shaft extension, gearing or other mechanical connections, and many other features. Hence it is not feasible to manufacture such machines and keep them in stock in lots with the same simplicity and advantages as in the case of steam engines, pumps, lathes, etc., which do not have so many variations.

Sixth—There has been a tendency to build, extend and equip electrical manufacturing plants to take care of the maximum demand in good times. Until a few months ago the times had been very bad in the electrical machinery business for several years. Consequently to keep the shop occupied orders had been taken at prices which gave little or no profit. That is, any business is better than no business. Of course, that has an extremely depressing effect on prices.

HIGHER PRICES PREDICTED

Dr. Crocker said that the statements made by him which are given above apply to the prices at which electrical apparatus has generally been sold in the past. At the present time the costs of materials and labor have greatly increased compared with those of a few months ago. Nevertheless, electrical machinery has not been materially advanced in price. Of course, prices have increased somewhat, but this rise is much less and later than that in the cost of materials and labor. They should, of course, increase in direct proportion. Hence prices of electrical apparatus must be expected to be higher very soon to conform to the present market for materials and labor. In the opinion of Dr. Crocker, they will go still higher in the future if materials and labor costs show further increase, which is likely to occur.

Nickel-Chromium Patent Situation

Prominent Electrical Heating-Device Manufacturers to Be Licensed Under Marsh Patent

Negotiation by the manufacturers of electrical heating devices using an alloy of nickel and chromium as a heating element in regard to the acceptance of the terms offered by the Hoskins Manufacturing Company and the General Electric Company for licensing under the Marsh patent jointly owned by these two companies are still pending.

The patent, No. 811,859, was granted to A. L. Marsh for an electric resistance element on Feb. 4, 1906, and was assigned to the Hoskins Manufacturing Company, which manufactures electric furnaces. The patent claims the use as a resistance element of an alloy of nickel and chromium. The alloy, being particularly adaptable to heating devices, was widely used without license by heating-device manufacturers.

To protect its patent the Hoskins company brought suit against the General Electric Company, charging that company with infringing the patent. The General Electric Company showed that its element, called calorite, while containing chromium and nickel, also contained in addition 15 per cent of iron and 8 per cent of manganese. This, it was held by the United States Circuit Court of Appeals, in no way avoided infringement of the Marsh patent. The iron and manganese acted simply as diluents. As a result the Hoskins company won its suit against the General Electric Company.

The Hoskins Manufacturing Company also brought a suit against a large and prominent central station to compel it among other things to pay not only present and future royalties, but all back royalties as well. This threatened to cause a considerable upheaval in the entire central-station field. In order to obtain rights under the patent to ward off the attack on the central stations and protect this field as far as possible, the General Electric purchased a third interest in the patent.

The two companies as joint owners of the patent announced several months ago to prominent manufacturers of electrical heating devices and equipment their intention of authorizing the use of nickel chromium as a resistance element by a license under the patent, and since then frequent meetings of those interested have been held in New York and Detroit. It is expected that these negotiations will be brought to a satisfactory close within a short time.

It is not the intention of either company to hold up the heating-device industry, and it is understood that the general terms under which these licenses will be granted are very liberal, and not such as will handicap the industry.

LEGAL DECISION

Suit was brought by the Hoskins Manufacturing Company against the General Electric Company in the District Court of the United States for the Northern District of Illinois, which granted an injunction and accounting, whereupon the General Electric Company appealed to the United States Circuit Court of Appeals. The last-named court held that the General Electric's use of the alloy, nickel-chromium, was an infringement of the Marsh patent, No. 811,859, and should be restrained.

The claims of the patent are five in number: Claim one calls for an electric resistance element composed of an alloy consisting of one of the metals of the chromium group and of a metal having the property of nickel and cobalt, combined in the proportion of more than 50 per cent of the latter and less than 50 per

cent of the former; claim two calls for a like element comprising a strip, strand or filament formed of an alloy of nickel and one of the metals of the chromium group; claim three carries the last-named strip, etc., annealed; claim four calls for a like resistance element formed of a metal alloy consisting of nickel and chromium; claim five calls for a like resistance element formed of a metal alloy consisting of less than 50 per cent of chromium and more than 50 per cent of nickel.

"The object," says the patentee, "is to provide as an improved electric resistance material a metal which has the property of being particularly low in electrical conductivity, has a melting point exceeding that of pure copper, and may be drawn or otherwise shaped to form particularly durable, efficient and desirable strips, strands or filaments suitable for use in various connections where electric resistances are desirable." He also says: "Iron is readily oxidizable and will not answer my purpose when alloyed."

While the patent was still in the Patent Office the patentee made certain changes to meet the objections of the examiner which the General Electric held amounted to an abandonment of the alloy.

The strongest reference against the validity of the patent was that to the English patent granted to Emile Placet, which was not before the examiner nor known to Marsh at the time of his invention, according to the records. The Placet patent relates to a method of introducing pure chromium into metals and alloys in a state of fusion. "This chromium," Placet says, "is absolutely pure. It improves all metals and alloys with which it is mixed by imparting to them the qualities peculiar to itself. It renders them harder, more resistant to shocks, tension and friction, and also renders them more proof against the destructive action of the air, moisture, acids and high temperatures. Chromium renders metals and alloys more resistant than heretofore to high temperatures, and increases the electrical resistance of manganese, ferro-manganese, ferro-nickel and other metals employed in the manufacture of conductors of high electrical resistance."

It was testified by Marsh that his discovery came, not through disclosures made by Placet, but by accident, when he was working in another field. The Hoskins company contended that Placet did not contemplate a complete operative resistance element, but merely meant to make a statement concerning the physical property of resistivity; that a disclosure of resistance is not a disclosure of a resistance element, and that alloys do not necessarily partake proportionately of the properties of their ingredients.

The General Electric Company sought to purchase the patent and, failing, took the Hoskins company's alloy of nickel and chromium and added a small quantity of manganese and 15 per cent of iron, admittedly for the purpose of coming within the alleged disclosures of the Placet patent. These additions, the Hoskins company contended, served merely as diluents and in no appreciate degree affected the characteristics of the alloy. This element is termed colorite and contains nickel 65 per cent, iron 15 per cent, chromium 12 per cent and maganese 8 per cent. The Hoskins company insisted that for purpose of durability as an electrical resistance element it is practically identical with its own element.

The General Electric Company contended that the claims were narrow and must be strictly construed, that its own resistance element did not infringe the claims as they read, that construed in the light of prior art and the file wrapper the claims cannot cover Marsh's element, which comes within the Placet patent and Marsh's abandoned claim four, although Placet shows no alloy used as a high-resistance element having less than 56 per cent of iron.

The invention of electric heating appliances had begun, and it was apparent that the need of conductors having great durability when subjected to heat was at hand. This involved also substances which possessed the property of ductility to a degree sufficient to permit the drawing of filaments, strands, wires, etc., for use as electrical conductors. Platinum alone was recognized as an enduring material suitable for conductors which were required to be subjected to great heat, but its cost prohibited its commercial use, and consequently the Marsh discovery was hailed as an available substitute.

The court says: "It was and is a most valuable resistance material, and it lasts, when subjected to heat from 800 deg. C. to 1000 deg. C., 150 times as long as anything in the prior art except platinum, unless Placet may be construed to have disclosed the concept; for unless Placet anticipates Marsh's material as an electrical resistance element it is not anticipated. It will be seen from Placet's English patent that the patentee leaves it to others to ascertain by experiment products of chromium and metals in alloy suitable for high resistance and those disclosing the element of resistance to high temperature. Placet's discoveries were before the public for almost eleven years before Marsh's patent was granted, from which fact it may be at least conjectured that the valuable resistance and duration properties as resistance elements which appellant finds disclosed therein were not ostentatiously in evidence. Now, the law is well settled that in order to anticipate a later invention the prior description must be such as to show that the article described in the patent can be certainly arrived at by following the prior description without the assistance of local knowledge or local prior use in the locality where the description is published, and without experimentation."

The main feature of the patent, in the opinion of the court, relied upon as new is the fact that Marsh found by experiment that the alloy of the patent combined with great resistivity marvelous durability second only to platinum, under conditions which made its production commercially practicable. Placet says that chromium renders certain metals more resistant to higher temperatures, which is not durability. "At most he (Placet) is speaking of externally applied heat, which is no criterion for durability under internally developed heat."

It seemed clear under the authorities, the court held, that Marsh was entitled to a patent for the service he rendered in rescuing the alloy from obscurity and placing it in the forefront of electrical resistance elements.

The court deemed it a fair deduction from the evidence that Marsh was not thinking of a diluent of iron but of iron as a substitute for nickel or a body for his alloy. From the record it appeared that for the purposes of an all-around element of great specific resistivity, including the essential companion property of endurance or resistance, to the encroachment of high temperature, etc., 15 per cent of iron has no appreciable effect on a chromium and nickel alloy. For all practical purposes for use in electric heating and cooking appliances and other devices employing high temperature the two resistances were held to be identical.

"Thus it is apparent," says the court, "that iron and manganese serve no purpose other than as diluents and as fictitious bases upon which to construct a claim for non-meritorious distinctions between the composition of the two alloys. Neither composition is new, and when applied in electrical resistance elements the results are identical, as is the appearance of the two. There is no other dissimilarity than the presence of small and inconsequential ingredients of iron and manganese in appellant's alloy. The new use is the same."

Results of Tests on High-Head Waterwheels

Method of Making Water Tests and Electrical Measurements—Calculating Losses and Arriving at Final Results for Operation at 580-Ft. Head

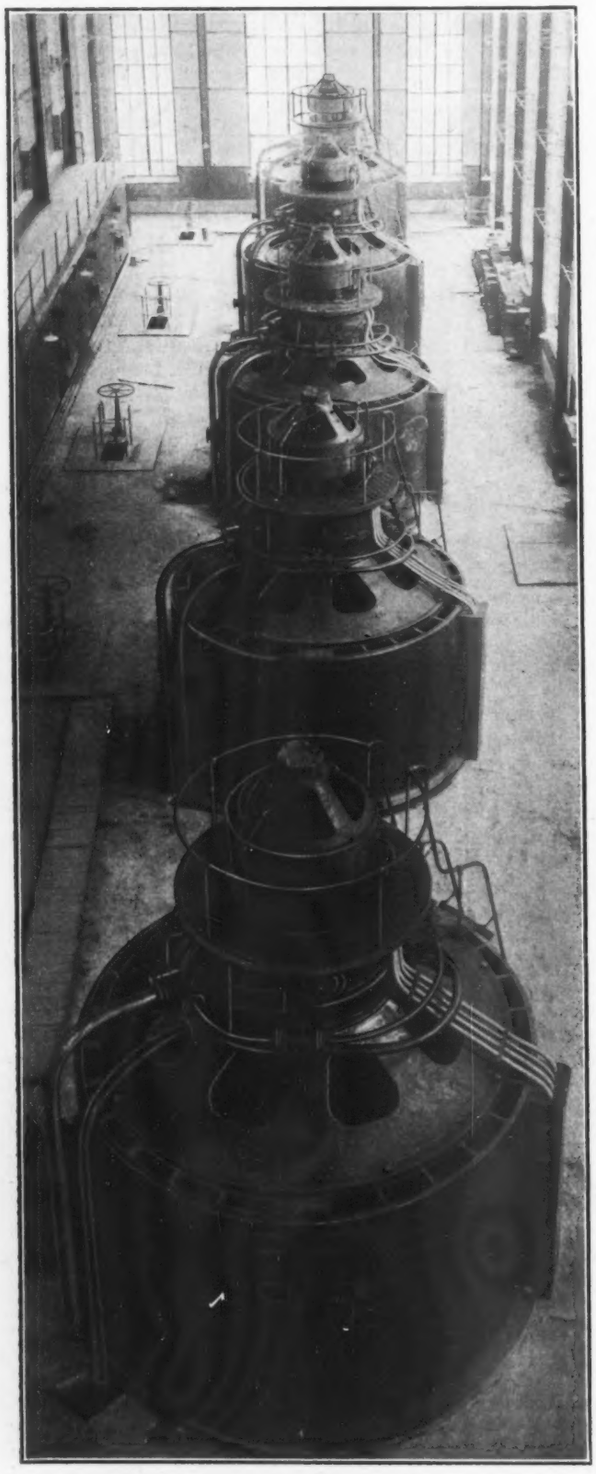


FIG. 1—GENERATOR FLOOR OF TALLULAH FALLS STATION

The generators shown are operated by the highest-head reaction turbines in this country. Mounting the exciters on the dome of the generators has obviated the use of separate waterwheels, auxiliaries and penstocks, and in addition has permitted securing a high over-all plant efficiency. The rotating element of each unit is supported by a single oil-pressure thrust bearing situated between the exciter and the generator.

THE waterwheels in the Tallulah Falls station of the Georgia Railway & Power Company were placed in service during the latter part of September, 1913. They were originally specified for a normal rating of 16,000 hp. at 580 ft. effective head when operating at 514 r.p.m. with the generators connected to them rated at 10,000 kw. On account of the fact that the design of the generators exceeded contract specifications, it was found that they could carry 12,000 kw. continuously at 80 per cent power-factor and a temperature rise not exceeding the specifications for 10,000 kw. (40 deg. C.). The waterwheel ratings were therefore modified by the builders and increased to 18,000 hp. normal, to conform with the increase in generator rating. The units have carried 19,000 hp. during tests. Five units are installed with provision for a sixth, making the ultimate station capacity 108,000 hp. under normal operating conditions. These units have been in continuous service since being installed.

The waterwheels are of the vertical shaft, commonly known as the Francis type, equipped with bronze runners and forged steel gates. The wheel shaft is of a special grade of forged steel, made in two sections, the lower 14 in. and the upper section 16 in. in diameter. The complete shaft weighs 20,000 lb., and the complete turbine unit weighs 300,000 lb. The spiral casing of each unit is made of special grade cast iron in one piece, with an inlet diameter of 45 in. connected to a hydraulically operated 45-in. gate valve for cutting off the water from the spiral case. A 20-in. nozzle tangentially opposite the 45-in. inlet is provided on the scroll case equipped with a 20-in. heavy gate valve and a 20-in. relief valve, the latter being under the control of the governor. The relief valve is designed to discharge 70 per cent of the discharge of the turbine under operating head with sudden closing of the gates, and is connected to the scroll case of each waterwheel on a center line with the penstock connection.

The discharge from the wheels is through draft tubes, the upper section of which is of cast iron fitted with two large man doors directly opposite one another, and this section passes through a chamber under the turbine floor from which acess can be had to the draft tube under the runner. The lower end of this section terminates in a cast-iron curbing which is built into the floor of this chamber, and the connection between the draft tube and the curbing is made by means of a bell and spigot joint. To the lower flange of this curbing is riveted a draft tube made of plate steel and built into the concrete from the floor of this chamber to the point where it discharges into the tailrace. The center of the wheel is set 22 ft. above the level of water in this tailrace.

While the waterwheels were designed to operate under and tests were computed for a net effective head of 580 ft., the actual head under which the plant operates is 606 ft., owing to the natural fall of the Tallulah River and a 110-ft. dam. This is at present the highest head under which turbine wheels are being operated in the United States. Other details of this installation were given in the ELECTRICAL WORLD for Dec. 20, 1913.

Determining Bonus Payment for Waterwheels

By contract agreement between the builder of the wheels and the Georgia Railway & Power Company the

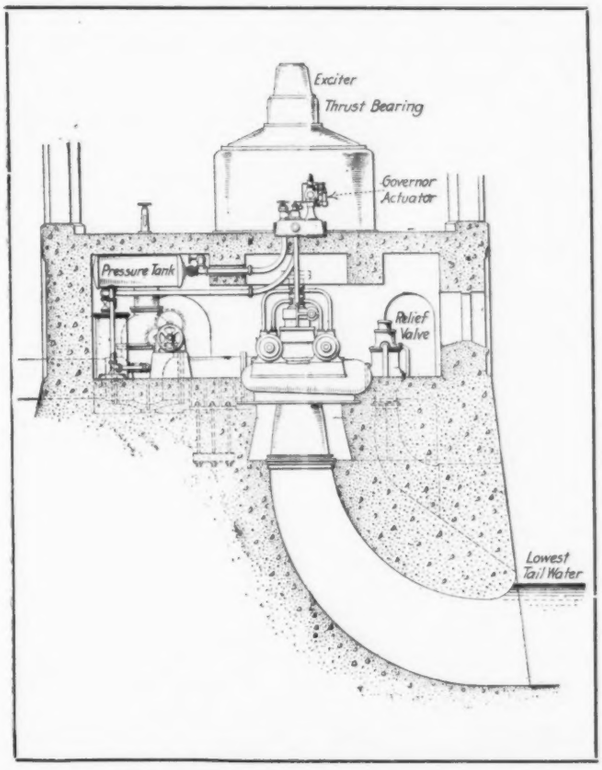


FIG. 2—SECTION SHOWING WATERWHEEL SETTING, INLET, RELIEF VALVE AND DRAFT-TUBE CONNECTIONS

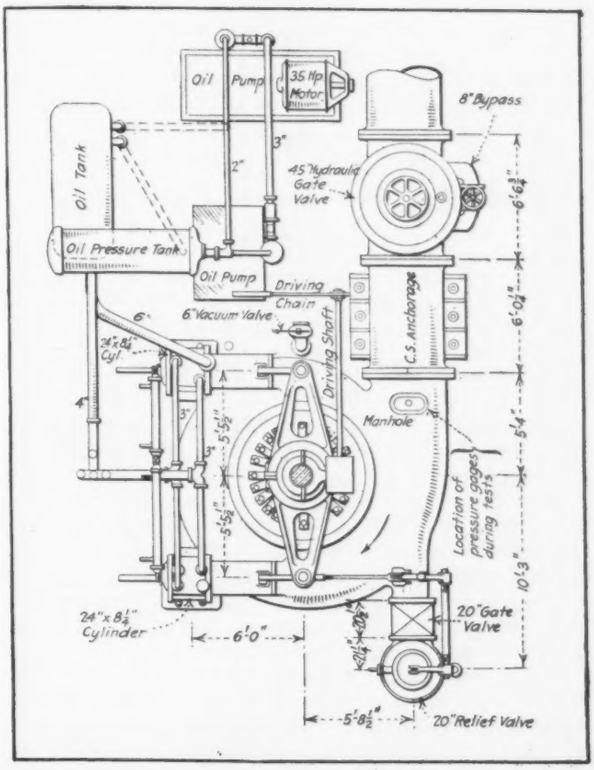


FIG. 4—PLAN OF TURBINE SETTING SHOWING ARRANGEMENT OF CONTROL EQUIPMENT

units were to be tested before acceptance to determine the amount of bonus or forfeiture to be considered in connection with the contract price. This bonus or forfeiture by agreement was based on the difference between 83 per cent and the efficiency shown by test when the unit was developing 0.8 of its maximum power (about 19,000 hp.) at 514 r.p.m. under 580-ft. head.

RESULTS FROM TESTS

The tests are described as follows: There were five units installed and in operation. It was decided to test three of these units, and for convenience of operation Nos. 2, 3 and 4 were selected, and during the test of each of these machines the other four were shut down and their hydraulically operated gate valves closed. The efficiency of unit No. 2 at 80 per cent of its maximum output was 88.3 per cent. The highest efficiency for this unit was 89.3 per cent at 0.76 gate opening and 16,750 hp. The efficiency of unit No. 3 at 80 per cent of its maximum output was 89.9 per cent. The highest efficiency for this unit was 90.4 per cent at about 0.75 gate opening and 16,875 hp. The efficiency of unit No. 4 at 80 per cent of its maximum output was 88.7 per cent. The highest efficiency for this unit was 89.50 per cent at approximately 0.76 gate opening and 16,900 hp.

A standard weir was installed in the end of the tailrace on the concrete wall, which had been built for the purpose. This weir was 30 ft. long with two end contractions and was provided with still boxes on each

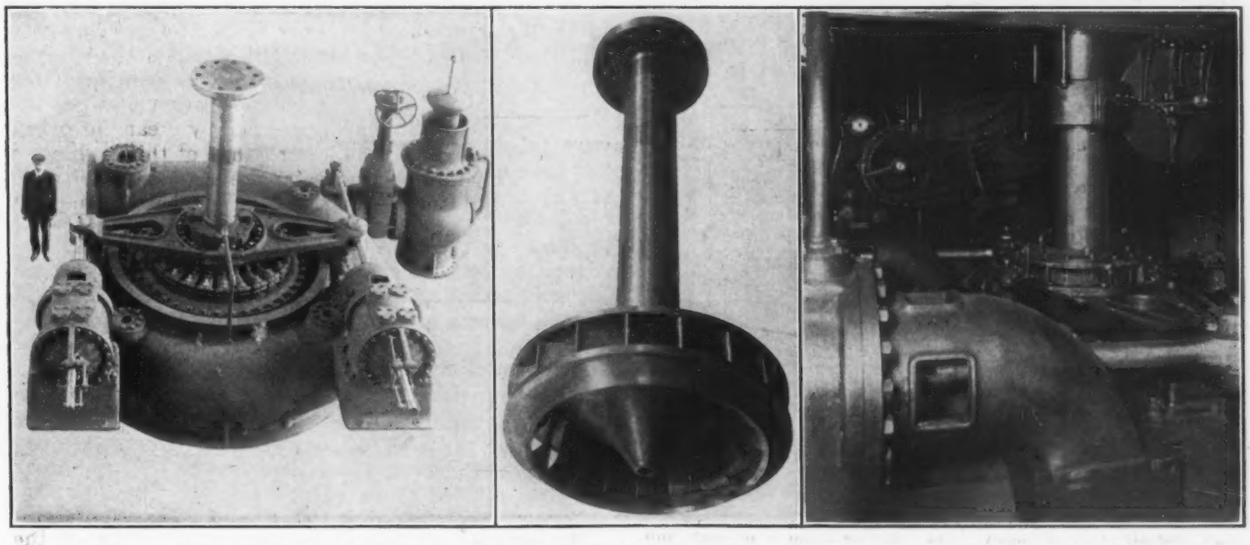


FIG. 3—ONE OF THE 17,000-HP. FRANCIS WATERWHEELS, ITS RUNNER, AND A VIEW OF IT AS INSTALLED IN TALLULAH FALLS STATION

end, which were connected with a pipe crossing the water channel 8 ft. above the weir and 4 ft. below the crest of the weir. A number of holes were drilled through the lower section of this pipe (which crossed the tailrace) for free access of water through same to the still boxes. In each of these still boxes the depth of water over the weir was measured by means of hook gages. Prof. C. M. Allen of Worcester, Mass., took the water readings from this weir. In addition to this there was a pitometer installed in the supply pipe of each unit, the reading of which was taken by Edward S. Cole of the Pitometer Company of New York, and the quantities of discharge used were the average of those obtained by these two readings. In addition to this, the supply pipe of each unit is equipped with a Venturi meter, and the readings of this meter were recorded by the engineers of the Georgia Railway & Power Company. All electrical readings were taken by the engineers of the Georgia Railway & Power Company. Both the S. Morgan Smith Company and the Georgia Railway & Power Company had a representative at the plant during these tests, and these representatives had free access to all stations and all readings. After the completion of the work at Tallulah Falls, all gages used during the test were taken to the government laboratory at Atlanta and calibrated, and all electrical instruments used during the test were sent to laboratories in Atlanta and in New York and carefully calibrated. All weir readings were taken to Worcester by Professor Allen, who worked up the final quantities therefrom, and all pitometer readings, together with the pitometer, were taken by Edward S. Cole and were calibrated at the laboratory of the Worcester Polytechnic Institute and, with the assistance of Prof. C. M. Allen, the final quantities were computed therefrom. The results as given above were based on same.

ELECTRICAL MEASUREMENTS

Each of the waterwheels is directly connected to a 10,000-volt normal-rating alternating-current generator, which has an exciter mounted on the waterwheel shaft with a governor pump mechanically connected to each wheel. Another pump, electrically driven, is also used for each wheel. The electrical measurements were taken for the purpose of determining, in the most convenient and correct manner, the output of the turbines.

The load on the generators was obtained by means of two three-phase, star-connected, 63,500-volt water rheostats connected on the primary side of the station step-up transformers, giving approximately equal loads on the three phases at approximately unit power-factor. The output of the generators was measured by means of a standard indicating wattmeter connected to instru-

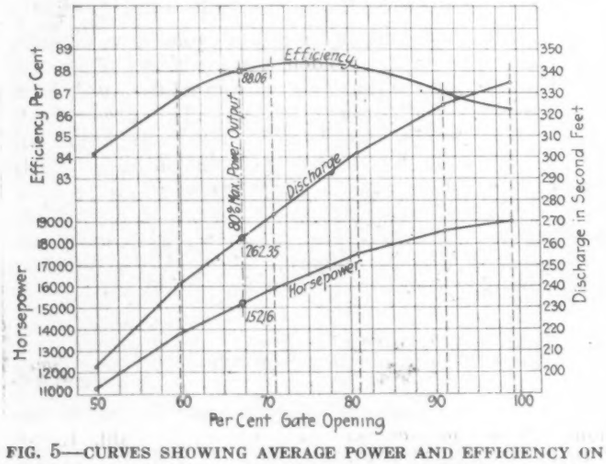


FIG. 5—CURVES SHOWING AVERAGE POWER AND EFFICIENCY ON WHICH BONUS FOR WATER WHEELS WAS ACCEPTED AND PAID

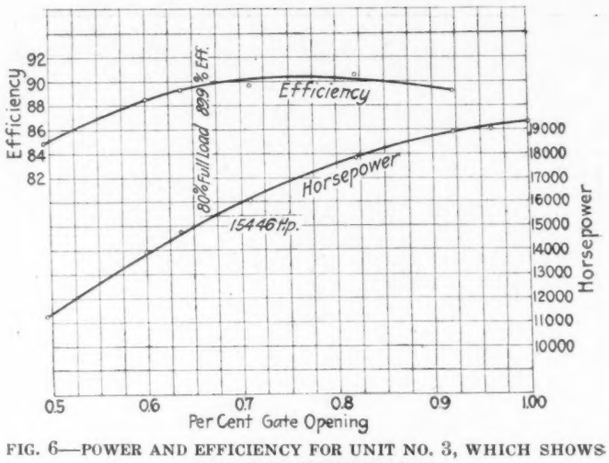


FIG. 6—POWER AND EFFICIENCY FOR UNIT NO. 3, WHICH SHOWS THE BEST PERFORMANCE

ment transformers which were connected to the generator terminals. The current and two potential transformers were connected in open delta on the secondaries and connected to the coils of the indicating wattmeter to measure the total output. In addition to the indicating wattmeter, a standard watt-hour meter, an indicating ammeter and voltmeter were used. The ammeter and voltmeter were transferred to all the three phases for three-phase readings.

In order to avoid errors due to ratio of transformation in the transformers used with the instruments, the two-current and potential transformers were carefully checked in a testing laboratory and proper allowance was made for errors, as shown by the calibration tests. Temperature errors were not present since the types of meters used would not change their indications with the slight difference in temperature from the temperature at the laboratory during the check. Careful attention was given to eliminate the effect of stray field errors. During the tests readings were taken simultaneously at all points at one-minute intervals, the starting time being given by flashing all station lights, all watches having been set to agree before beginning the test. At least five accurate readings with steady load were taken at all points on the power curve, namely, 50 per cent, 60 per cent, 70 per cent, 80 per cent and 90 per cent gate openings, and also as many readings at 100 per cent gate opening as were necessary. The 80 per cent power point was then calculated and ten readings were taken at this load in order to have an accurate point on the curve near that point where the finally calculated 80 per cent power output would fall.

EFFICIENCIES OF GENERATOR AND EXCITER

The efficiencies of the exciters for the various outputs were taken from a large-sized efficiency curve, which had been plotted from data obtained from the shop tests of the machine builders. The exciter outputs were divided by the efficiencies taken from the curve in order to obtain the exciter input. Efficiency curves for the generators were plotted from shop-test data of each machine, and the efficiencies obtained from these curves for the various outputs were used to obtain the generator input. The efficiencies obtained in this way included excitation.

The power delivered to the waterwheel shaft was derived by taking the generator output and dividing it by the shop efficiency of the generator, which included the excitation among other losses. The exciter output was then divided by its shop efficiency. These two results were then added together, and from this sum a deduction for excitation was made. The final result was the net power delivered to the waterwheel shaft.

HYDRAULIC CALCULATIONS

The discharge of the weir was corrected for the velocity of approach in the following manner: The cross-section of the channel 8 ft. above the weir was taken, and from this area corresponding to the depth of water over the weir the velocity of approach was obtained by dividing the discharge by this area, and the increased discharge due to the velocity of approach was obtained by the formula $h = \frac{V^2}{2g}$. The weir discharge was then taken as the average corrected discharge for both ends of the weir. The leakage from various sources was measured with the plant at rest by reducing the weir to 1-ft. length. This leakage was found to be 0.25 cu. ft. per second, and this amount was deducted from all final discharges.

The test results were reduced to the head specified in the contract agreements, namely, 580 ft., by the use of the following formula:

$$\frac{P_1}{\sqrt{H_1^3}} = \frac{P}{\sqrt{H^3}}$$

where P_1 is the power as tested, H_1 is the head as tested, P is the power at 580-ft. head, and H is 580 ft. The discharge of the wheel to correspond with the head of 580 ft. was calculated by the use of the following formula:

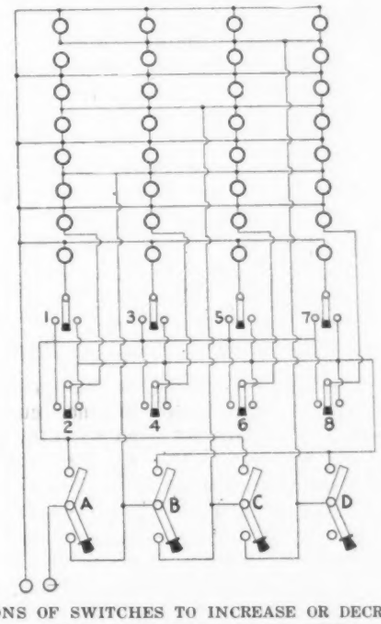
$$\frac{Q_1}{\sqrt{H_1}} = \frac{Q}{\sqrt{H}}$$

where Q_1 is the discharge as tested, Q is the discharge at 580-ft. head, H_1 is head as tested, and H is 580 ft. The data from field tests were checked and recalculated from original field-test data by C. O. Lenz, chief engineer Georgia Railway & Power Company, 71 Broadway, New York City, and accepted by the machine builders as basis for the bonus payment on the waterwheels.

Convenient Switching Arrangement for a Lamp Bank

BY R. H. LANGLEY

In many cases where lamp banks are used as resistance a number of single-pole, single-throw knife switches are employed, each controlling a group of lamps with each group having a different number of lamps. The accompanying diagram shows an arrangement used by the writer by which the current may be increased or decreased by half-ampere steps (if 16-cp., 110-volt lamps are used) up to the full rating of the bank. The diagram shows thirty-two lamps, eight small switches, numbered 1 to 8, and four large switches, lettered *A, B, C, D*. Each of the small switches controls one lamp, and each of the large switches controls one group of eight lamps. In case it is desired to build the current up by half-ampere steps from 0 amp. to 16 amp., the operation of the switches is as follows: Switch *A* is closed upward. This connects one side of the line to the left side of all the switches 1 to 8. By closing switches 1 to 8 successively to the left, eight lamps are lighted, one at a time. Switch *A* is then thrown down. This puts out the eight unit lamps and replaces them with group 1 of eight lamps. In the same way close *B* upward. This connects the line to the *right* side of switches 1 to 8, and by closing 1 to 8 successively to the right all the unit lamps are lighted. Now throw *B* down. This puts out the unit lamps again and lights group 2 of eight lamps. By closing switch *C* upward, the line is connected again to the left side of the unit switches, which are again closed to the left. This process is continued till all the lamps are lighted. The current is decreased by operating the switches in the reverse order. The entire load may be cut off at any time by opening switch *A*. The opposite side of the line is connected permanently to all the lamps as shown.



CONNECTIONS OF SWITCHES TO INCREASE OR DECREASE LAMP-BANK CURRENT IN SMALL STEPS

It is obvious that the same system may be applied to any number of lamps. It is advisable to have twice as many small switches as large switches. The large switch *A* carries the full current. Any size lamps may be used, or they may be replaced by a resistance unit of any convenient form.

The small switches are of the type commonly used as magneto switches on stationary gasoline engines and motorboats. The large switches are of the extended knife type, and in the case shown are of 25-amp. rating. They are used in order that the time required for the throw-over may be short. A bank of this kind was built by the writer for use in his laboratory, and all the parts were purchased and the entire bank assembled in one day. It has been found very useful and convenient to operate.

Submarine Cables Laid Across Golden Gate

Two 11,000-volt submarine power cables have recently been laid across the Golden Gate at San Francisco for the extension in that city of the Pacific Gas & Electric Company distributing system. The power is to come from Cordelia substation at high voltage and will be stepped down at a transformer station on the north side of the Golden Gate to 11,000 volts, at which pressure it will be transmitted under the water to the city substations. The cables, which are about 13,000 ft. long, were laid under unusual difficulties, incident to swift currents and deep water, as well as to dangers in the heavy fogs from the shipping that plies in and out continuously through the entrance to the harbor. However, the work was completed on schedule time and the cables successfully passed the 22,000-volt test to which they were subjected immediately after the work was done. The contract was held by A. J. Pahl, K-P-F Electric Company, San Francisco.

Busbar Data for Outdoor Switching Structures

Structural and Electrical Characteristics of Suitable Materials, Including Iron and Steel Pipes, and Methods of Using These Data in Designing Outdoor Switching Stations

BY C. A. MEES
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IN designing outdoor substations and switching stations structural as well as electrical characteristics of different busbar materials must be known so that the structure can be built at a minimum cost consistent with the service it is expected to give. If consideration be given in design only to conductivity and the structural strength is allowed to come to what it will, many times the expense of supporting the busbars will amount to more than it should. Busbar design, therefore, involves a balancing of the cost of busbar material against the cost of supporting and installing it, so that the combined expense will be a minimum. While copper is the material of which busbars are usually constructed, it is not the only material that can be used and straps are not the only shapes which should be installed. Under some conditions aluminum, brass, or even iron or steel, may be desirable, and tubing is often preferable with high voltages because the skin effect is not so noticeable.

Results of investigations of busbar material and dimensions made by the writer for outdoor stations are given in the data tabulated herewith. The structural characteristics of different sizes and kinds of pipe and the formulas should assist in the design of pipe framework such as is commonly employed in transmission-line switching stations and other outdoor structures.

To show how the accompanying data may be utilized in ascertaining the relative values of different busbar materials, a specific case has been worked out. It is assumed that a busbar B in the accompanying diagram must support two cross-busbars A_1 and A_2 at the points indicated and that each must carry 1650 amp. The distance between the supports of busbar B is 153 in., and the length of both cross-busbars is 15 ft. One-half of each cross-busbar must therefore be supported by busbar B. The busbar materials which will be considered are indicated in the first column of Table XIII. In the fifth column are the tensile strengths taken from Table I, giving a factor of safety of five. The permissible current densities, taken from Table II, are in the next to the last column.

Starting with this information, the size and cross-section of tubing required, so far as electrical conductivity is concerned, may be determined by referring to Tables IV to XII. Under the permissible current density look for the total current which must be carried. On the same line to the left the size and cross-sectional area of the tube required are given. The cross-section required for strap material is easily computed by dividing the total current by the permissible current density.

To find the weight per foot of rectangular sections, multiply the cross-section in inches by twelve and by the weight per cubic inch (shown in Table I). The weight per foot of pipe may be read direct in Tables V to VIII. By substituting the computed weight in the formula for obtaining the maximum bending moment in a uniformly loaded beam with two symmetrically placed concentrated loads, the following is obtained:

$$M_{max} = \frac{\text{Wt. } B \times 153}{8} + \frac{\text{Wt. } A \times 55}{2}$$

By inserting M_{max} as computed from this equation and f, as given in Table I, in the formula $S = M_{max} \div f$, the required section modulus of busbar B is obtained.

To ascertain whether the tube size previously selected for conductivity has the correct section modulus, Tables V to VIII are referred to, and the values of S as found there are compared with the required value S as com-

TABLE I—PROPERTIES OF BUSBAR MATERIALS

Material	Tensile Strength (Lb./Sq. In.)		Weight (Lb.)		Relative Conductivity (per cent)
	Ultimate	Working†	Cu. Ft.	Cu. In.	
Copper, hard drawn	50,000	10,000	555	0.321	100
Copper, annealed	25,000	5,000	550	0.318	103
Aluminum, 99.5 per cent pure	25,000	5,000	168	0.0975	62
*Brass, rolled	45,000	9,000	530	0.307	60
Iron, wrought	55,000	11,000	480	0.278	14.5
Steel, medium	80,000	16,000	490	0.283	.....

*Ordinary rolled brass—60 per cent copper and 40 per cent zinc; best brass wire—70 per cent copper and 30 per cent zinc.
†With factor of safety of 5.

TABLE III—CONSTANTS FOR USE IN COMPUTING DEFLECTION

Material	E	$C = 5/384E$	$C' = 1/48E$
Wrought iron and steel	28,000,000	0.000,000,000,465	0.000,000,000,744
Annealed copper	16,000,000	0.000,000,000,814	0.000,000,001,302
Commercial brass	13,500,000	0.000,000,000,965	0.000,000,001,531
Aluminum (cast bars)	11,500,000	0.000,000,001,132	0.000,000,001,812

TABLE II—CURRENT DENSITIES EMPLOYED BY WRITER

Service	Maximum Bus. Length (Ft.)	Material	Circ. Mils/Amp.	Amp./Sq. In.
D.C.	Short	Copper bars and tubing	1000	1250
D.C.	Short	Brass tubing and aluminum bars	1600	800
D.C.	50	Copper bars and tubing	1200	1000
A.C. lighting	75			
D.C.	50	Brass tubing and aluminum bars	2000	650
A.C. lighting	75			
A.C. inductive	75	Copper bars and tubing	1500	850
A.C. inductive	75	Brass tubing and aluminum bars	2500	500
A.C. inductive	200	Copper bars and tubing	1600	800
A.C. inductive	200	Brass tubing and aluminum bars	2700	475

TABLE IV—PERMISSIBLE CURRENT DENSITIES (ORDINARY PRACTICE

Copper bars: 1000 circ. mils/amp. or 1000 amp. /sq. in.

Aluminum bars*: 1000 amp./sq. in. for small sizes

750 amp./sq. in. for general work

500 amp./sq. in. for largest sizes.

*1.56 times cross-sectional area of copper bars, of same conductivity; therefore greater current densities can be allowed with aluminum bars because of their greater radiating surface.

Physical and Structural Properties of Pipes and Tubing

TABLE V—WROUGHT-IRON AND STEEL STEAM, GAS AND WATER PIPE (STANDARD IRON-PIPE SIZES)

Diameter (in.)			S-in.³	I-in.⁴	r-in.²	Area (sq. in.)	Weight (lb./lin.ft.)
Nominal	Inside	Outside					
⅛	0.623	0.840	0.0405	0.0260	0.262	0.2503	0.837
¼	0.824	1.050	0.0704	0.0370	0.334	0.3327	1.115
½	1.048	1.315	0.0959	0.0630	0.420	0.4972	1.668
¾	1.380	1.660	0.2341	0.1944	0.562	0.6685	2.244
1	1.611	1.900	0.3248	0.3085	0.623	0.7995	2.678
1¼	2.067	2.375	0.5996	0.6646	0.787	1.0740	3.609
1½	2.468	2.875	1.0642	1.5298	0.947	1.7120	5.739
2	3.067	3.500	1.7242	3.0174	1.163	2.2380	7.536
2½	3.548	4.000	2.3896	4.7792	1.337	2.6800	9.001
3	4.026	4.500	3.2087	7.2197	1.509	3.1750	10.665
3½	4.508	5.000	4.1555	10.3887	1.681	3.6750	12.340
4	5.045	5.563	5.4770	15.1856	1.880	4.3210	14.501
4½	6.065	6.625	8.4086	28.0921	2.245	5.5860	18.762
5	7.023	7.625	12.1785	46.4334	2.590	6.9210	23.271
6	7.982	8.625	16.7674	72.3095	2.948	8.4050	28.177
7	8.937	9.625	22.4312	107.9506	3.283	10.0400	33.701
8	10.019	10.750	29.6158	160.6550	3.673	11.9400	40.065

TABLE VII—WROUGHT-IRON AND STEEL PIPE (DOUBLE EXTRA HEAVY)

Diameter (in.)			S-in.³	I-in.⁴	r-in.²	Area (sq in.)	Weight (lb./lin.ft.)
Nominal	Inside	Outside					
2	1.491	2.375	1.1089	1.3168	0.705	2.686	9.02
2½	1.755	2.875	2.0055	2.8829	0.842	4.073	13.68
3	2.284	3.500	3.4398	6.0196	1.045	5.524	18.56
3½	2.716	4.000	4.9388	9.8777	1.206	6.772	22.75
4	3.136	4.500	6.8239	15.3539	1.371	8.180	27.48
4½	3.564	5.000	9.0877	22.7192	1.535	9.659	32.53
5	4.063	5.563	12.0708	33.5749	1.722	11.341	38.12
6	4.875	6.625	20.1410	66.7176	2.056	15.807	53.11

TABLE VII—SEAMLESS COPPER AND BRASS TUBING (STANDARD IRON-PIPE SIZES)

Diameter (in.)			s-in.³	I-in.⁴	r-in.²	Area (sq.in.)	Weight (lb./lin.ft.)	
Nominal	Inside	Outside					Copper	Brass
⅛	0.625	0.840	0.0403	0.0169	0.262	0.2474	0.95	0.90
¼	0.822	1.050	0.0708	0.0372	0.333	0.3352	1.31	1.25
½	1.062	1.315	0.1280	0.0842	0.423	0.4723	1.79	1.70
¾	1.368	1.660	0.2412	0.2005	0.560	0.6944	2.63	2.50
1	1.600	1.900	0.3342	0.3174	0.620	0.8247	3.15	3.00
1¼	2.062	2.375	0.5664	0.6732	0.786	1.0907	4.20	4.00
1½	2.500	2.875	0.9976	1.4336	0.950	1.5831	6.04	5.75
2	3.062	3.500	1.7405	3.0456	1.160	2.2572	8.72	8.30
2½	3.500	4.000	2.5955	5.1909	1.330	2.9449	11.45	10.90
3	4.000	4.500	3.3559	7.5491	1.505	3.3380	13.33	12.70
3½	4.500	5.000	4.2128	10.5319	1.700	3.7307	14.60	13.90
4	5.062	5.563	5.2932	14.7278	1.880	4.1808	16.54	15.75
4½	6.125	6.625	7.6768	25.4293	2.256	5.0069	19.23	18.31
5	7.062	7.625	11.4789	43.7634	2.598	6.4943	25.53	23.74
6	8.000	8.625	16.3499	70.5092	2.941	8.1607	32.10	29.86

TABLE VIII—WROUGHT-IRON, STEEL, COPPER AND BRASS PIPE (EXTRA HEAVY)

Diameter (in.)			S-in.³	I-in.⁴	r-in.²	Area (sq. in.)	Weight (lb./lin.ft.)		
Nominal	Inside	Outside					W.I. and Steel	Copper	Brass
⅛	0.542	0.840	0.0480	0.0202	0.250	0.3235	1.09	1.33	1.20
¼	0.736	1.050	0.0861	0.0452	0.321	0.4405	1.39	1.75	1.66
½	0.951	1.315	0.1619	0.1064	0.402	0.6478	2.17	2.48	2.36
¾	1.272	1.660	0.2940	0.2438	0.523	0.8934	3.00	3.47	3.30
1	1.494	1.900	0.4152	0.3945	0.604	1.0823	3.63	4.46	4.25
1¼	1.933	2.375	0.7370	0.8749	0.778	1.4955	5.02	5.73	5.46
1½	2.315	2.875	1.3464	1.9404	0.923	2.2827	7.67	8.72	8.30
2	2.892	3.500	2.2432	3.9255	1.135	3.0523	10.25	11.76	11.20
2½	3.358	4.000	3.1568	6.3136	1.306	3.7097	12.47	14.39	13.70
3	3.818	4.500	4.3026	9.6809	1.475	4.4551	14.97	17.33	16.50
3½	4.181	5.563	7.4186	20.6339	1.839	6.1130	20.54	23.94	22.80
4	5.750	6.625	12.3260	40.8297	2.193	8.4960	28.58	33.60	32.00

Note.—Extra-heavy tubing has the same properties as extra-heavy wrought- iron and steel pipe, except as to weights.

Ampere Capacity of Seamless Tubing

TABLES IX AND X—STANDARD IRON-PIPE SIZES

Size (in.)	Sect. Area (circ. mils)	Current Density (circ. mils per amp.)						
		1000	1200	1500	1600	2000	2500	2700
⅛	315,000	315	262	210	197	157	126	117
¼	426,790	427	356	285	267	213	171	158
½	601,351	601	501	401	376	301	241	223
¾	884,138	884	737	589	553	442	354	327
1	1,050,041	1,050	875	700	656	525	420	389
1¼	1,388,723	1,389	1,157	926	868	694	555	514
1½	2,015,666	2,016	1,680	1,344	1,260	1,008	806	747
2	2,873,957	2,874	2,395	1,916	1,796	1,437	1,150	1,064
2½	3,749,565	3,750	3,125	2,500	2,343	1,875	1,500	1,389
3	4,250,075	4,250	3,542	2,833	2,656	2,125	1,700	1,574
3½	4,750,076	4,750	3,958	3,167	2,969	2,375	1,900	1,759
4	5,323,162	5,323	4,436	3,569	3,327	2,662	2,129	1,972
4½	6,374,985	6,375	5,312	4,250	3,984	3,187	2,550	2,361
5	8,268,802	8,269	6,891	5,513	5,168	4,134	3,308	3,063
6	10,390,530	10,390	8,659	6,927	6,494	5,195	4,156	3,811

Size (in.)	Sectional Area (sq. in.)	Current Density (Amp. per sq in.)						
		1250	1000	850	800	650	500	475
⅛	0.2474	309	247	210	198	161	124	117
¼	0.3352	419	335	285	268	218	168	159
½	0.4723	590	472	401	378	307	236	224
¾	0.6944	868	694	590	555	451	347	330
1	0.8247	1,031	825	701	660	536	412	392
1¼	1.0907	1,363	1,091	927	873	709	545	518
1½	1.5831	1,979	1,583	1,346	1,266	1,029	791	752
2	2.2572	2,821	2,257	1,919	1,806	1,467	1,129	1,072
2½	2.9449	3,681	2,945	2,503	2,356	1,914	1,472	1,399
3	3.3380	4,172	3,338	2,837	2,670	2,170	1,669	1,586
3½	3.7307	4,663	3,730	3,171	2,985	2,425	1,865	1,772
4	4.1808	5,226	4,181	3,554	3,345	2,718	2,090	1,986
4½	5.0069	6,259	5,007	4,256	4,006	3,254	2,503	2,378
5	6.4943	8,118	6,494	5,520	5,195	4,221	3,247	3,085
6	8.1607	10,201	8,161	6,937	6,529	5,304	4,080	3,876

TABLES XI AND XII—EXTRA-HEAVY SIZES

¼	411,893	412	343	275	257	206	165	153
½	560,862	561	467	374	350	280	224	208
¾	824,805	825	687	550	515	412	330	305
1	1,137,513	1,137	948	758	711	569	455	421
1¼	1,378,028	1,378	1,148	919	861	689	551	510
1½	1,904,130	1,904	1,587	1,270	1,190	952	762	705
2	2,906,425	2,906	2,422	1,938	1,817	1,453	1,163	1,077
2½	3,886,310	3,886	3,239	2,591	2,428	1,943	1,555	1,691
3	4,723,338	4,723	3,936	3,149	2,952	2,362	1,889	1,749
3½	5,672,412	5,672	4,727	3,782	3,545	2,836	2,269	2,101
4	7,783,316	7,783	6,486	5,189	4,865	3,892	3,113	2,883
4½	10,817,447	10,817	9,014	7,212	6,761	5,409	4,327	4,006

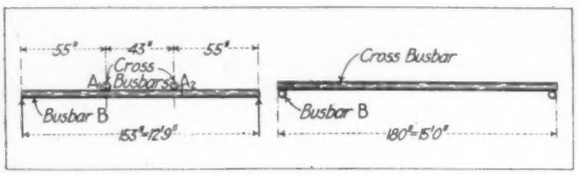
¼	0.3235	404	323	275	259	210	162	154
½	0.4405	551	440	374	352	286	220	209
¾	0.6478	810	648	551	518	421	324	308
1	0.8934	1,117	893	759	715	581	447	424
1¼	1.0823	1,353	1,082	920	866	703	541	513
1½	1.4955	1,869	1,495	1,271	1,196	972	748	710
2	2.2827	2,853	2,283	1,940	1,826	1,484	1,141	1,084
2½	3.0523	3,815	3,052	2,594	2,442	1,984	1,526	1,450
3	3.7097	4,637	3,710	3,153	2,968	2,411	1,855	1,762
3½	4.4551	5,569	4,455	3,787	3,564	2,896	2,228	2,116
4	6.1130	7,641	6,113	5,196	4,890	3,973	3,056	2,904
4½	8.4960	10,620	8,496	7,222	6,797	5,522	4,248	4,036

puted. The dimensions chosen for strap material should be such that their product is the cross-section required for conductivity and also such that when they are substituted in the formula $S = (bd^2) \div 6$ (where b is the thickness and d the depth of a strap laid on edge) a value equal to or greater than the required sectional modulus is obtained.

The dimensions required to prevent a deflection of more than 1/360 of the span may also be determined from the tables with the help of the following formulas:

Case 1.—Bar supported at both ends and uniform load.

$$\text{Required } I = \frac{5Wl^2}{384ED} = \frac{CWl^2}{D}$$



CONDITIONS ASSUMED FOR EXAMPLE SHOWING APPLICATION OF DATA

Case 2.—Bar supported at both ends and load concentrated at mid-span.

$$\text{Required } I = \frac{Pl^3}{48ED} + \frac{5W_1l^3}{384ED} = \frac{l^2(C'P + CW_1)}{D}$$

Case 3.—Bar supported at both ends and two symmetrical loads.

$$\text{Required } I = \frac{Pa(3l^2 - 4a^2)}{24ED} + \frac{5W_1l^3}{384ED}$$

$$= \frac{C'Pa(6l^2 - 8a^2) + CW_1l^3}{D}$$

In which a is distance from load to nearest support; W is total load (in pounds) uniformly distributed and including weight of bar; W_1 is total weight of bar (in pounds); P is load (in pounds) concentrated; l is length of span (in inches), and D is deflection (in inches).

The values of E, C and C' are given in Table III. When I is computed, the size of tube needed can be ascertained by using Tables V to VIII.

In the selection of straps for busbars it must be borne in mind that twisting occurs before the safe limits for other phenomena are reached. By experiment the following limitations have been obtained: The unsupported span should not exceed 7 ft. 6 in. for copper and 10 ft. for aluminum. Furthermore, it has been found that these spans should not be attempted without providing rigid clamps over separators at a spacing not exceeding 3 ft. 9 in.

For columns or struts use a maximum ratio of slenderness $l \div r = 120$ and $P = 19{,}000 - (100l) \div r$ up to a maximum value of 13,000 lb. per square inch.

TABLE XIII—CURRENT 1650 AMP. (SEE DIAGRAM)

Metal	Size	Wt./Lin. Ft.	M (in Lb.)	F (Lb./Sq. In.) Factor of Safety, 5	S Required	S Actual	Conductivity (Amp.) Per Sq. In.	Conductivity (Amp.) Total
Aluminum	2 in.x¼ in.x5¼ in.	3.00	2,235	5,000	0.45	2.88	620	1,628
Aluminum	2 in.x⅜ in.x4¼ in.	3.04	2,235	5,000	0.45	1.88	620	1,647
Hard copper	2 in.x¼ in. x3¼in.	6.74	4,710	10,000	0.47	1.02	1,000	1,750
Soft copper	2 in.x¼ in.x3¼ in.	6.74	4,710	5,000	0.94	1.02	1,000	1,750
Seamless copper tube	2½ in. std.	6.04	4,375	10,000	0.44	1.00	1,000	1,583
Seamless copper tube	2 in. ex. h.	5.73	4,140	10,000	0.41	0.74	1,000	1,496
Seamless brass tube	3 in. std.	8.30	5,910	9,000	0.66	1.74	600	1,354
Seamless brass tube	2½ ex. h.	8.30	5,910	9,000	0.66	1.35	600	1,370
Seamless brass tube	3½ std.	10.90	7,545	9,000	0.84	2.60	600	1,767
Seamless brass tube	3 in. ex. h.	11.20	7,775	9,000	0.86	2.24	600	1,831

TABLE XIV—USEFUL CROSS-SECTION EQUIVALENTS

1 mil = 0.001 in.

1 circ. mil = 0.7854 sq. mil.

1 sq. mil = 1.273 circ. mil.

1 sq. in. = 1,273,240 circ. mils = 1,000,000 sq. mils.

Data on Operations of a Motor-Driven Sand Pump

BY STUART C. IRBY

Motor-driven sand pumps have been in successful operation for some time by the Inland Gravel Company at Hattiesburg, Miss., to pump sand from the bed of a pit and deliver it to railroad cars. The installation consists of a 150-hp., sixty-cycle, three-phase, 2300-volt induction motor, operating at 720 r.p.m. and belt-connected to a Morris centrifugal sand pump operating at 600 r.p.m. Pump and motor are installed on a barge and in one operation deliver washed gravel directly to the railroad cars ready for shipment. A sloping screen is mounted over the car in such a way that the gravel from the mixture discharged on it from the pump is separated out and falls into the car, while the water and sand passes through the screen and down a sluiceway. The sand is recovered by means of a settling pond and sold for building purposes.

Only three men are required to operate the pumping equipment, while five were formerly required when steam-driven equipment was used. The maximum daily output is eight cars of washed gravel (about 80,000 lb. each) and approximately three times as much sand.

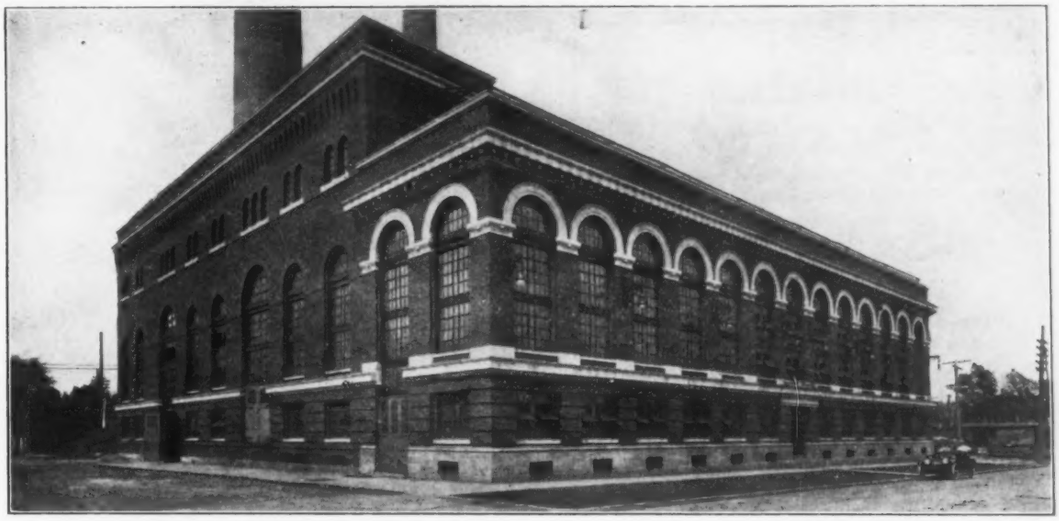
The monthly cost of operating the motor-driven pump according to the bills rendered is shown in the accompanying table.

The cost of pumping the sand and gravel varies considerably owing to the changing distances between the barge and screen; however, the average kilowatt-hour cost per car of gravel for this installation is around $125, with 300 kw.-hr. as the maximum energy demand.

The motor is operated from the system of the Hattiesburg Traction Company at a rate based on 2½ cents per kilowatt-hour up to 10,000 kw.-hr. consumed and 2 cents per kilowatt-hour for energy used over 10,000 kw.-hr. The motor is operated on an average forty hours per week.

MONTHLY COST OF OPERATING 150-HP MOTOR DRIVING SAND PUMP

Month	Energy Used by Motor, Kw.	Amount of Bill
March	6,760	$169.00
April	12,740	254.80
May	11,010	220.20
June	15,690	313.80
July	13,940	278.80



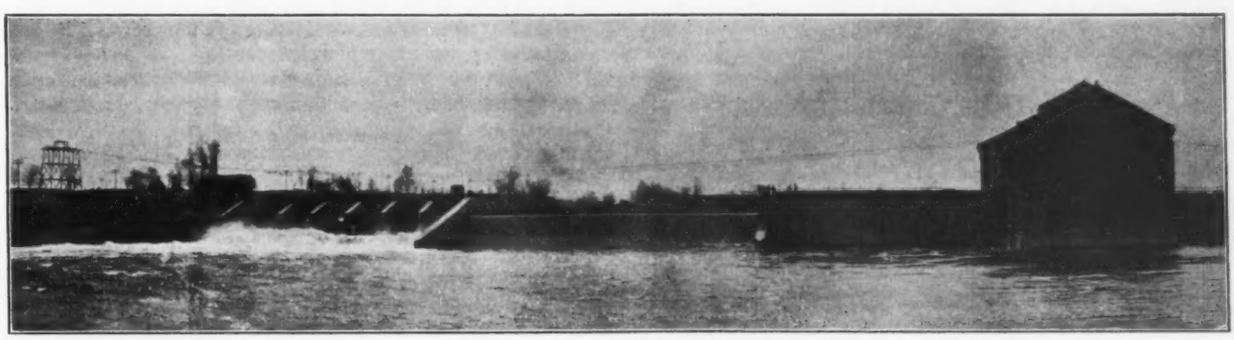
THE SOUTH BEND (IND.) STEAM-TURBINE STATION OF THE INDIANA & MICHIGAN ELECTRIC COMPANY

Advertising a Community to Win Power "Prospects"

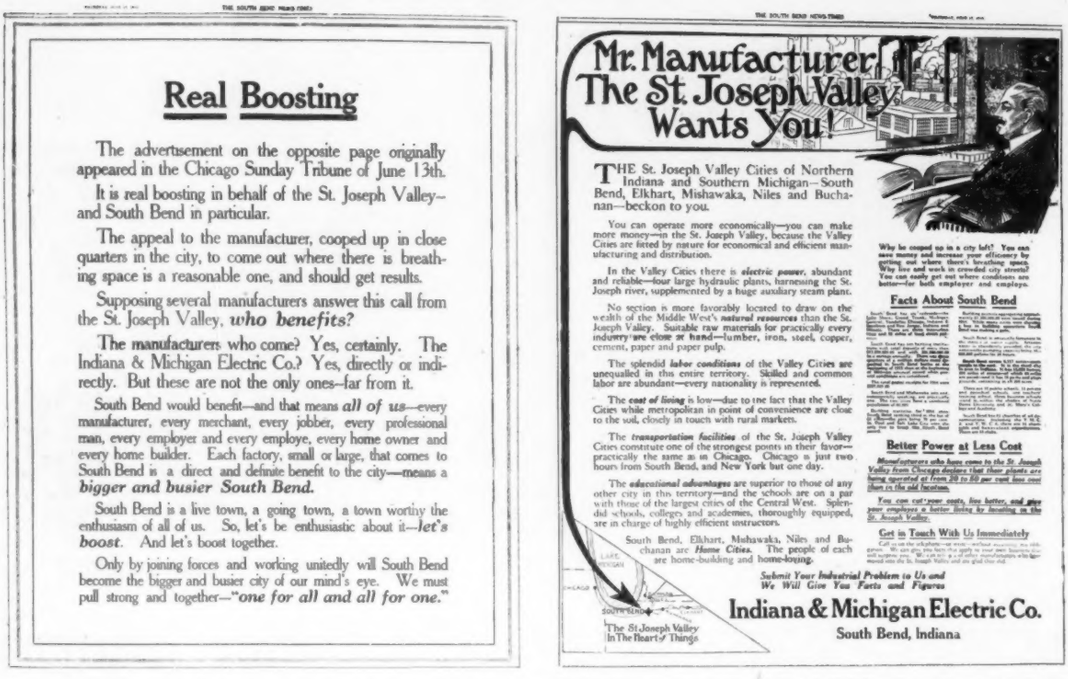
Among progressive utility managers it is an axiom that whatever advances a community's interests also promotes the fortunes of its public-service corporations. Although knowing this, few of these managers have as yet backed this belief by spending money to any considerable amount to advertise their communities. Some have, but these events are still sufficiently rare to give a flavor of progressive novelty to such an advertising campaign as has recently been featured in Chicago newspapers by the Indiana & Michigan Electric Company of South Bend, Ind. It is an interesting story taken in itself, and yet it has a greater value to the industry. It is a bit of evidence, a blaze along the trail that leads to broader methods of co-operative participation in the kind of civic work that brings both popularity and profits on a scale that every central station naturally is eager for.

THE Indiana & Michigan Electric Company of South Bend, Ind., operates in the St. Joseph Valley and serves the valley cities of South Bend, Elkhart, Mishawaka, Niles and Buchanan. Situated so near Chicago, these thriving cities are "in the heart of things," as they are wont to phrase it, and F. A. Bryan, president and general manager of the central station, is strong in his conviction that a great industrial future awaits the growth of population throughout this territory. He believes also that this period of waiting may be shortened very considerably by progressive methods of publicity that will secure the attention and awaken the interest of Chicago manufacturers and convince them that they can find in these neighboring St. Joseph Valley cities better conditions than they now enjoy in the more congested metropolis. Therefore he decided recently that the central station might well afford to lead the way in such a work, because the power service offered such advantages as to insure an income from at least a fair proportion of new industries attracted, and so a campaign was prepared to advertise the "Valley Cities" in Chicago.

In brief, the South Bend company's plan was carried out as follows: Advertising space to the extent of about three pages was purchased in the Chicago (Ill.) *Tribune* for both Sunday and daily issues. In this space an appeal was made to manufacturers operating in Chicago to move their plants to South Bend, just two hours distant by rail. Reasons for making the change were, of course, stated, and after these advertisements had appeared in Chicago they were in turn reproduced in the South Bend daily papers and in the local Chamber of Commerce *Bulletin*. Arrangements were made to follow up all inquiries resulting from the Chicago advertisements by mail or by personal calls as the occasion demanded. In general, the scheme of the campaign was



THE BERRIEN SPRINGS (MICH.) WATER-POWER PLANT ON THE ST. JOSEPH RIVER, THE FLOW OF WHICH IS ALSO UTILIZED FURTHER UP STREAM BY THE BUCHANAN (MICH.) AND ELKHART (IND.) PLANTS OF THE COMPANY



Real Boosting

The advertisement on the opposite page originally appeared in the Chicago Sunday Tribune of June 13th.

It is real boosting in behalf of the St. Joseph Valley—and South Bend in particular.

The appeal to the manufacturer, cooped up in close quarters in the city, to come out where there is breathing space is a reasonable one, and should get results.

Supposing several manufacturers answer this call from the St. Joseph Valley, ***who benefits?***

The manufacturers who come? Yes, certainly. The Indiana & Michigan Electric Co.? Yes, directly or indirectly. But these are not the only ones—far from it.

South Bend would benefit—and that means ***all of us***—every manufacturer, every merchant, every jobber, every professional man, every employer and every employe, every home owner and every home builder. Each factory, small or large, that comes to South Bend is a direct and definite benefit to the city—means a ***bigger and busier South Bend.***

South Bend is a live town, a going town, a town worthy the enthusiasm of all of us. So, let's be enthusiastic about it—***let's boost***. And let's boost together.

Only by joining forces and working unitedly will South Bend become the bigger and busier city of our mind's eye. We must pull strong and together—"***one for all and all for one.***"

Mr. Manufacturer The St. Joseph Valley Wants You!

THE St. Joseph Valley Cities of Northern Indiana and Southern Michigan—South Bend, Elkhart, Mishawaka, Niles and Buchanan—beckon to you.

You can operate more economically—you can make more money—in the St. Joseph Valley, because the Valley Cities are fitted by nature for economical and efficient manufacturing and distribution.

In the Valley Cities there is ***electric power***, abundant and reliable—***four*** large hydraulic plants, harnessing the St. Joseph river, supplemented by a huge auxiliary steam plant.

No section is more favorably located to draw on the wealth of the Middle West's ***natural resources*** than the St. Joseph Valley. Suitable raw materials for practically every industry ***are close at hand***—lumber, iron, steel, copper, cement, paper and paper pulp.

The splendid ***labor conditions*** of the Valley Cities are unequalled in this entire territory. Skilled and common labor are abundant—every nationality is represented.

The ***cost of living*** is low—due to the fact that the Valley Cities while metropolitan in point of convenience are close to the soil, closely in touch with rural markets.

The ***transportation facilities*** of the St. Joseph Valley Cities constitute one of the strongest points in their favor—practically the same as in Chicago. Chicago is just two hours from South Bend, and New York but one day.

The ***educational advantages*** are superior to those of any other city in this territory—and the schools are on a par with those of the largest cities of the Central West. Splendid schools, colleges and academies, thoroughly equipped, are in charge of highly efficient instructors.

South Bend, Elkhart, Mishawaka, Niles and Buchanan are ***Home Cities***. The people of each are home-building and ***home-loving***.

Why be cooped up in a city loft? You can save money and increase your efficiency by getting out where there's breathing space. Why live ***and*** work in crowded city streets? You can easily get out where conditions are better—for both employer and employe.

Facts About South Bend

Better Power at Less Cost

Manufacturers who have come to the St. Joseph Valley from Chicago declare that their plants are being operated at from 20 to 50 per cent less cost than in the old location.

You can cut your costs, live better, and give your employes a better living by locating in the St. Joseph Valley.

Get in Touch With Us Immediately

Submit Your Industrial Problem to Us and We Will Give You Facts and Figures

Indiana & Michigan Electric Co.

South Bend, Indiana

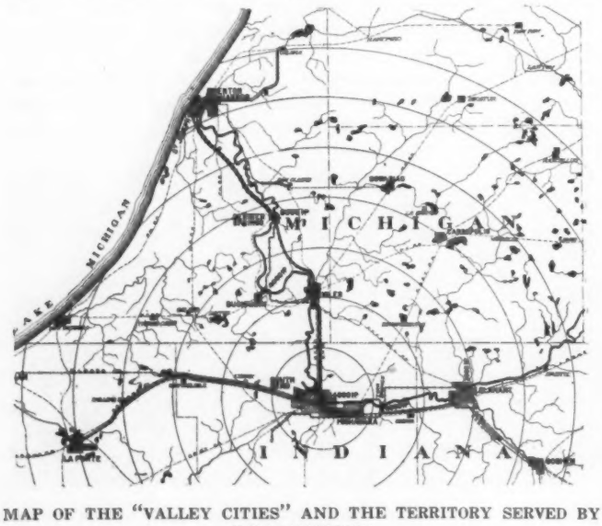
The St. Joseph Valley In The Heart of Things

THE "OPENING-GUN" ADVERTISEMENT IN THE METROPOLITAN CAMPAIGN AS REPRODUCED, WITH A PAGE OF COMMENT, IN THE SOUTH BEND PAPERS FOUR DAYS LATER

very much like those which have been used by many local co-operative commercial bodies in boosting their home towns, but, considered from all angles, "It had any Chamber-of-Commerce plan beaten to death," to use the words of an interested advertising man. He, of course, was thinking of the results produced.

But, to get back to the plan, it should be said that in its details it held much of interest. The South Bend company's first advertisement occupied a full page in the Chicago papers. It was addressed to the metropolitan manufacturer, and it offered to make a concrete proposition for improving his working conditions and his profits, an argument that hit the manufacturer at his vulnerable point. Then, too, there was much interesting information about the strategic position of the cities in the St. Joseph Valley, to which he was being invited to move. The whole story was concise, and it was readable.

This full-page "ad" was then reproduced at home, also in a full page in the South Bend dailies, and on the page facing it was published, at the expense of the Indiana & Michigan Electric Company, another full page of text in explanation of the campaign. It was pointed out that every citizen of South Bend would be benefited by the electric company's advertising. The arguments presented almost proved that a corporation has a soul. In fact, from a public-relations standpoint, reproducing the advertisements at home proved to be a stroke of real genius so favorably was it received. But we are getting ahead of our story.

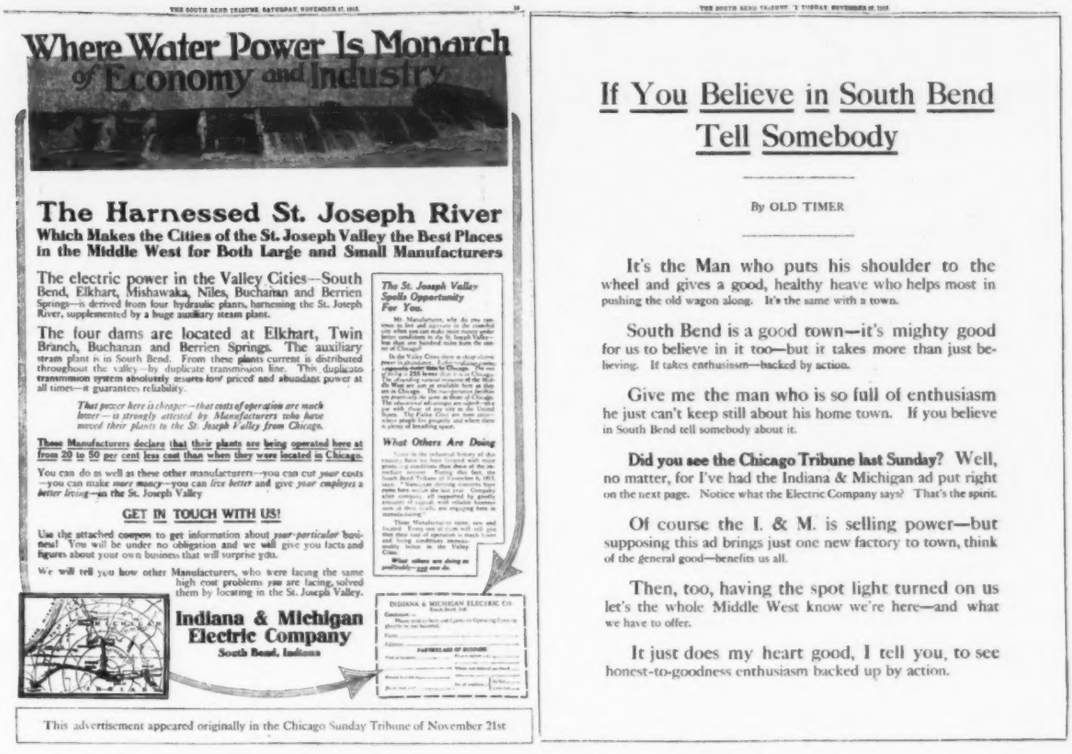


MAP OF THE "VALLEY CITIES" AND THE TERRITORY SERVED BY THE COMPANY

The second advertisement had news value. It dwelt at length upon one point which was only mentioned in the first advertisement. This feature turned upon the unexcelled labor conditions in the St. Joseph Valley, and the point was well taken, for just at that time a great street-railway strike had Chicago's industries in its grip. The unregulated "jitneys" were taking a daily toll of 50 cents from the toiler whose wage was less than $2 a day. Everybody was late to work. Manufacturing businesses were demoralized, for trucking in the down-town streets had ceased to be practicable. So the advertisement said: "Why, Mr. Manufacturer—why live and work in the turmoil of a crowded city with its strained relations? . . . Come to the Valley Cities." This advertisement, like all others, mentioned in an incidental manner the low rates available for electric service. It was signed, as were all of the series, by the Indiana & Michigan Electric Company, whose name appeared in type of medium size.

Following this second half page, at irregular intervals there appeared smaller pieces of copy ranging in size from one-sixteenth page to one-thirty-second page. These small advertisements repeated and emphasized much of the material used in the larger ones that preceded them.

Finally the campaign was closed by another full page in the Chicago *Tribune* for Sunday, which page, like the first one, was later reproduced with an appropriate explanation in the South Bend papers. The character of the material in this last page, however, was somewhat different from that which had preceded it. Water-power was here made the feature. Facts were given concerning the company's four hydroelectric plants, which harness the St. Joseph River at Elkhart, Twin Branch,



Where Water Power Is Monarch of Economy and Industry

The Harnessed St. Joseph River

Which Makes the Cities of the St. Joseph Valley the Best Places in the Middle West for Both Large and Small Manufacturers

The electric power in the Valley Cities—South Bend, Elkhart, Mishawaka, Niles, Buchanan and Berrien Springs—is derived from four hydraulic plants, harnessing the St. Joseph River, supplemented by a huge auxiliary steam plant.

The four dams are located at Elkhart, Twin Branch, Buchanan and Berrien Springs. The auxiliary steam plant is in South Bend. From these plants current is distributed throughout the valley—by duplicate transmission line. This duplicate transmission system absolutely assures low priced and abundant power at all times—it guarantees reliability.

That power here is cheaper—that costs of operation are much lower—is strongly attested by Manufacturers who have moved their plants to the St. Joseph Valley from Chicago.

These Manufacturers declare that their plants are being operated here at from 20 to 50 per cent less cost than when they were located in Chicago.

You can do as well as these other manufacturers—you can cut *your* costs—you can make *more money*—you can *live better* and give *your employees a better living*—in the St. Joseph Valley

GET IN TOUCH WITH US!

Use the attached coupon to get information about *your particular* business! You will be under no obligation and we will give you facts and figures about your own business that will surprise you.

We will tell you how other Manufacturers, who were facing the same high cost problems you are facing, solved them by locating in the St. Joseph Valley.

The St. Joseph Valley Spells Opportunity For You.

What Others Are Doing

Indiana & Michigan Electric Company

South Bend, Indiana

INDIANA & MICHIGAN ELECTRIC CO

This advertisement appeared originally in the Chicago Sunday Tribune of November 21st

If You Believe in South Bend Tell Somebody

By OLD TIMER

It's the Man who puts his shoulder to the wheel and gives a good, healthy heave who helps most in pushing the old wagon along. It's the same with a town.

South Bend is a good town—it's mighty good for us to believe in it too—but it takes more than just believing. It takes enthusiasm—backed by action.

Give me the man who is so full of enthusiasm he just can't keep still about his home town. If you believe in South Bend tell somebody about it.

Did you see the Chicago Tribune last Sunday? Well, no matter, for I've had the Indiana & Michigan ad put right on the next page. Notice what the Electric Company says? That's the spirit.

Of course the I. & M. is selling power—but supposing this ad brings just one new factory to town, think of the general good—benefits us all.

Then, too, having the spot light turned on us let's the whole Middle West know we're here—and what we have to offer.

It just does my heart good, I tell you, to see honest-to-goodness enthusiasm backed up by action.

A FULL-PAGE DISPLAY ADVERTISEMENT, WHICH FEATURED THE POWER OF THE HARNESSED ST. JOSEPH RIVER, REPRODUCED FOR THE BENEFIT OF THE HOME PUBLIC

Buchanan and Berrien Springs, and which contain generators rated at 3000 hp., 6000 hp., 4000 hp. and 9000 hp. respectively. Attention was also called to the 14,000-hp. steam stand-by station at South Bend, the center of the company's system, at which a steam unit is always held in readiness to be put on the lines. Stress was also laid on the fact that the company's transmission lines are all of the double-circuit type, insuring continuity of service. The advertisement also referred indirectly to the variety of industries already thriving in the Valley Cities and mentioned the low operating costs and low electricity rates enjoyed by these concerns. The advertisement summed up former arguments and urged the manufacturer to mail the attached coupon to the Indiana & Michigan Electric Company.

THE TWOFOLD RESULT

The benefits obtained from this unique and aggressive campaign must be viewed from two angles to gage the full results. The effect produced on the Chicago manufacturers was one important advantage, and the influence on the residents in the Valley Cities was another achievement, no less important. That many Chicago manufacturers, including important firms whose credit rating is A A A, were impressed by the advertisements is certain, for a stack of inquiries has been received from reputable concerns. What ultimate results will be obtained from following up these inquiries yet remains to be developed.

In the Valley Cities, however, the effect was still more pronounced and was immediate. What the people of these communities thought of the campaign and of the company conducting it may be summed up briefly by quoting from editorial articles in the South Bend papers. Under the title "New South Bend Spirit," the South Bend *Tribune* in its editorial columns said:

"South Bend and the other cities which happen by good fortune to be situated in the St. Joseph Valley owe recognition to the company which thus sets these communities in such favorable light before the manufacturers of Chicago. Without doubt the electric company will gain by the increased growth of these cities. Its work for the community is not entirely unselfish, but in working for itself the company has pointed the way for other South Bend concerns to benefit themselves by seeking to benefit the community first. The new South Bend spirit is spreading."

The South Bend *News-Times* a few days later said:

"We do not take it that the Indiana & Michigan claims that its advertising in the Chicago paper was purely Utopian. It is building for itself, but if it profits the probability is that South Bend will also profit. The placing of the St. Joseph Valley before a huge army of readers, such as the Chicago *Tribune* has, is a good invitation for the whole valley, and South Bend, as the metropolis of that valley, naturally stands in the foreground.

"It is the first time, so far as we can recollect, that any local enterprise has demonstrated so much of civic pride in its foreign advertising. The advertising tells the story of the St. Joseph Valley as well as the story of the Indiana & Michigan Electric Company. It is an invitation to locate along the valley where Indiana & Michigan power and light can be had, to be sure, but while the Indiana & Michigan is seeking that patronage, it is perforce seeking people likely to become patrons of the rest of us."

The newspapers merely voiced the sentiments of the business men of the community. But some of the business men were not content to let the newspapers do all of the complimenting. Men who formerly had been only lukewarm supporters of the Indiana & Michigan Electric Company now are real boosters for the company and its service, and Mr. Bryan of the electric company says that even had the advertising been less productive of manufacturers' inquiries it still would have been worth all it cost since it placed the electric company in its true light before the home people it seeks to serve.

The Commercial Standardization of Instrument Transformers

A Method of Establishing an Independent Current-Ratio Standard Without Laboratory Facilities

BY OTTO A. KNOPP

Engineer of Standardizing Laboratory, Pacific Gas & Electric Company, San Francisco, Cal.

Most laboratories of electric-service corporations are well equipped with the apparatus necessary to make a primary calibration of ammeters, voltmeters and watt-meters, but few are equipped to make a primary calibration of instrument transformers. Nearly all companies depend on a secondary standard transformer calibrated by some reliable and well-equipped laboratory. Some three years ago the writer found a discrepancy in the calibration of his standard series transformer at a time when it was contemplated to check the ratio of several series transformers to be used in an efficiency test on a steam-turbine generating unit.

To be independent of the delay incident to the rechecking of standards in some distant laboratory, an attempt was made to establish a standard. After numerous attempts with indicating and dynamometer type instruments had failed to give the desired accuracy of at least 0.1 per cent, a very simple and reliable method was developed, which in many respects is similar to the method recently described by P. G. Agnew[1] of the Bureau of Standards. It differs from Mr. Agnew's method in so far as use is made of some additional means, and it thus serves a new purpose, namely, the establishing of an independent current-ratio standard without laboratory facilities.

The method was as follows: Two induction-type watt-hour meters were adjusted so that one ran 10 per cent faster than the other. Both were mounted on a test board, one above the other, about 12 in. apart, as shown in Fig. 1, and underneath the lower meter a small mirror was placed at such an angle that with the meter covers removed the observer could see the black marks of the two disks traveling one alongside the other in the mirror. Then the speed ratio of the two meters was determined with potential coils in parallel and current coils in series, as shown in Fig. 2. The observer started counting the revolutions as soon as the two black marks exactly lapped in the mirror and noted the number of revolutions the faster meter had to make to gain one revolution on the slower one.

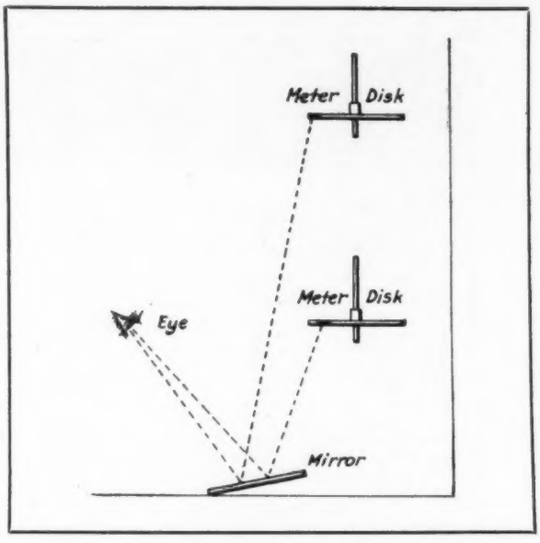


FIG. 1—METHOD OF OBSERVING VARIATION IN SPEEDS OF TWO WATT-HOUR-METER DISKS

In order to make use of this method for the establishment of a standard, a circular transformer core[2] was wound with primary and secondary of equal number of turns, such that the full-load ampere-turns of each winding numbered some 600 to 1000. By connecting this core in the watt-hour-meter circuits, as indicated in Fig. 3, the difference between primary and secondary currents was determined for values ranging from 5

[1] ELECTRICAL WORLD, Vol. 64, page 1004.

[2] Some current transformers are on the market where a circular hole is provided for the insertion of a primary winding. These can be used very conveniently. If the ratio, for instance, is 120 to 1, 120 turns have to be threaded through the opening.

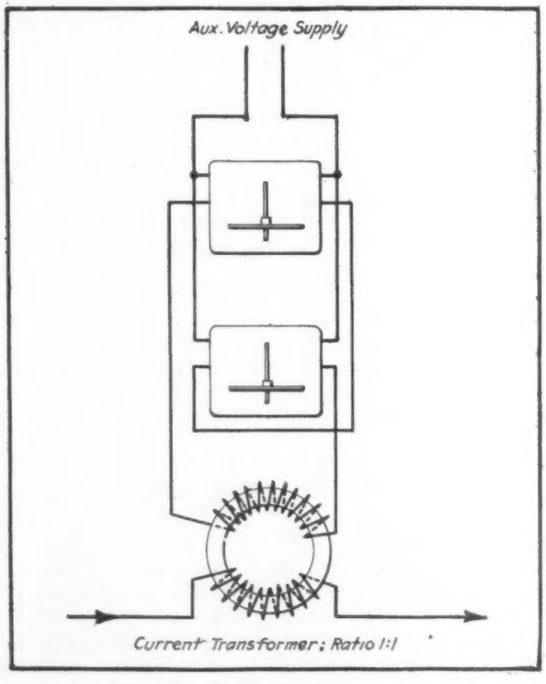


FIG. 2—CONNECTIONS FOR DETERMINING SPEED RATIO OF THE WATT-HOUR METERS USED

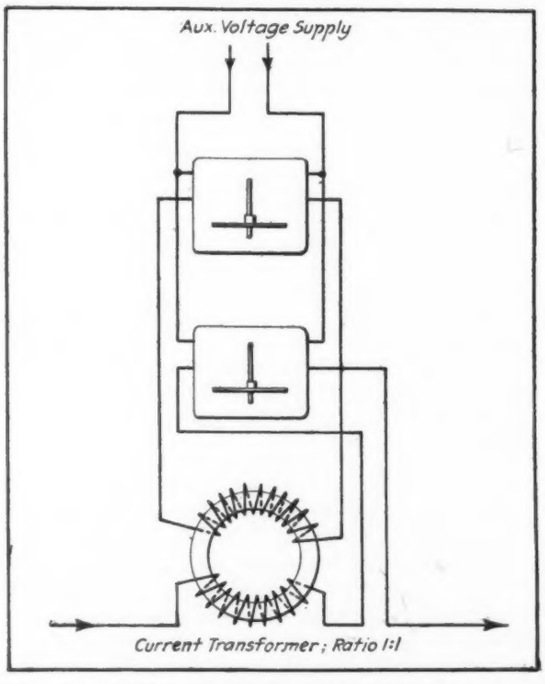


FIG. 3—CONNECTIONS FOR DETERMINING DIFFERENCE BETWEEN PRIMARY AND SECONDARY CURRENTS

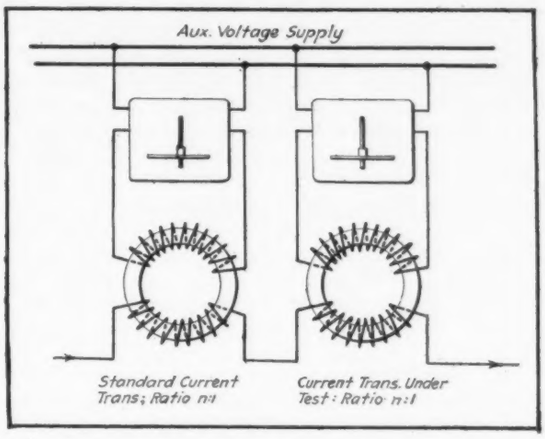


FIG. 4—METHOD USED BY P. G. AGNEW TO DETERMINE RATIO OF INSTRUMENT TRANSFORMERS

per cent to 100 per cent of full load. By operating the two watt-hour meters in the same way as before, but at 50 per cent power-factor, the additional error due to phase displacement was determined, and by referring to the convenient tables published by L. T. Robinson* the phase angle was computed.

That the above assumptions and the methods developed were correct was proved to our entire satisfaction a year later, in the spring of 1913, when our standard transformer calibrated in the above manner was checked by L. T. Robinson in the General Electric Company's laboratory, the result of this test agreeing with tests by the writer within a few hundredths of 1 per cent.

In the test method used by P. G. Agnew he compared the ratio of an instrument transformer against a standard one of the same ratio. In this method (Fig. 4) for every test of a transformer of given ratio a special standard is required, whereas in the above-described method a standard is established which is good for a large number of ratios. The means employed for establishing such standards of any ratio are identical with those employed by Mr. Agnew; namely, two watt-hour meters. The method of employing the two watt-hour meters is, however, somewhat different in each case.

*Transactions A. I. E. E., 1909, Part II, page 1005.

Calculation of Turbine Efficiency by Use of Mollier Diagram

Simple Means by Which an Operator May Compute Efficiency from Test Data

BY H. A. COZZENS, JR.

In examining the results of turbine trials it is often found that the figures under the heading of efficiency for one test differ from those for another test of a machine of the same design and rating. In many cases the discrepancy is obviously due to different methods of evaluating the heat performance of the turbine in arriving at the efficiency.

The term "efficiency" broadly means the relation existing between the output and the input of the machine. Since the losses may vary, the efficiency varies accordingly. With regard to the mechanical and the electrical efficiencies little need be said, as there is hardly any confusion as to the significance of these terms.

When computing the thermal efficiency, however, the matter becomes somewhat of a problem. The efficiency with regard to the heat performance may be divided into three classes—first, an efficiency that shows what the turbine really does in practical operation; second, what an ideal turbine without losses would do under like conditions, and, third, an efficiency which is a comparison of what the turbine actually does with what it is possible to do from a thermodynamic standpoint.

These three efficiencies will be defined and a practical example of a turbine trial quoted to illustrate the meaning of each. By use of these any operating engineer can readily analyze the efficiencies of his turbines.

The following turbine trial will be considered as an example in order to draw conclusions as to the efficiencies attained:

Steam pressure at throttle valve (gage), lb	205
Degrees of superheat, deg. Fahr	100
Vacuum at turbine exhaust, deg. Fahr	29.2
Temperature at this vacuum, deg. Fahr	72.2
Water rate, pounds per kilowatt-hour of steam	13.3

The actual efficiency of the turbine is the efficiency of the turbine as a heat engine in actual practice. This is the ratio of the output to the input, both measured in heat units. The output expressed as 1 kw. for one hour and measured in heat units is:

$$(60 \times 33{,}000 \times 1.34) \div 778 = 3412 \text{ B.t.u.}$$

The input is equal to

$$(H_1 - q_2)\,WR,$$

where H_1 is the total heat in 1 lb. of steam at the initial or throttle pressure; q_2 is the heat of the liquid in 1 lb. of steam at the terminal pressure or at the vacuum in the exhaust, and WR is the water rate of the turbine or the pounds of steam used in making 1 kw.-hr.

Then the efficiency will be:

$$E = \text{output} \div \text{input} = 3412 \div (H_1 - q_2)\,WR.$$

Applying the quantities given in the test, the expression for the actual efficiency becomes:

$$E = 3412 \div (1259.6 - 40.3)\,13.3 = 21.05 \text{ per cent.}$$

The ideal efficiency is that obtained by an ideal heat engine, and the general law (Carnot cycle) for this efficiency is:

$$E = (t_1 - t_2) \div T_1,$$

where t_1 is the temperature of the steam at the initial pressure, t_2 is the temperature of the steam at the terminal pressure, and T_1 or $t_1 + 460$ is the absolute initial temperature.

This general expression for the efficiency of an ideal engine must be modified, however, to suit different conditions, as the heat performance of the turbine varies according to the condition of the steam at the initial and final limits; that is, whether it is superheated, dry-saturated or wet, and the degree of wetness. These

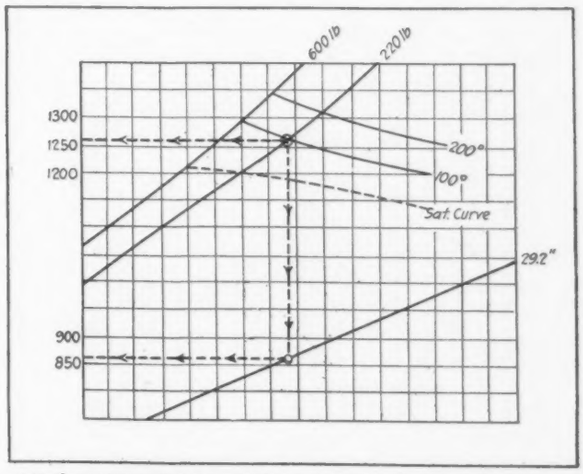


FIG. 1—SKELETON OF MOLLIER DIAGRAM SHOWING ITS USE

conditions demand the use of complex expressions, which are clumsy, if not altogether meaningless, to the operating man.

The relative efficiency is the ratio between the actual and the ideal efficiencies. This term is commonly alluded to as the "Rankine efficiency percentage," or sometimes ambiguously as the "Rankine efficiency." The relative efficiency is the most expressive means of stating the heat performance of the turbine. It is a comparison of what the turbine actually does as against the performance of an ideal turbine or engine, using the Rankine cycle as the base. This means of quoting the efficiency is most often used, since it gives a means of comparison.

USE OF DIAGRAMS AND FORMULAS

For the case in question the output per pound of steam for the actual turbine is $3412 \div 13.3 = 256.5$ B.t.u. To effect a comparison a like quantity must be found for the ideal turbine operating under the given conditions. This quantity, or the heat convertible by an engine in the Rankine cycle, may be determined by use of the following formula:

$$U = H_1 - q_2 - (N_1 - n_2)T_2,$$

in which H_1 and q_2 have the same meaning as before; N_1 is the entropy of the steam at the initial pressure, and n_2 is the entropy of water at the final pressure. T_2 = absolute temperature corresponding to final pressure. For the given example these values are:

$$U = (1259.6 - 40.3) - 532.2(1.6049 - 0.0787)$$
$$= 1219.3 - 811 = 408.3 \text{ B.t.u.},$$

which is the heat convertible by an ideal engine.

Another formula for the same quantity is:

$$U = H_1 - H_2 + (N_2 - N_1)T_2,$$

where H_2 is the total heat in 1 lb. of steam at the terminal pressure and N_2 is the entropy of steam at the terminal pressure. Applying the given quantities,

$$U = 1259.6 - 1091.3 + 532.2(2.0550 - 1.6049)$$
$$= 168.3 + 240 = 408.3 \text{ B.t.u.}$$

Then the relative efficiency would be

E = actual heat content ÷ ideal heat content
$= 256.5 \div 408.3 = 63.0$ per cent.

In computing the heat content much time can be saved by the use of the Mollier diagram, a convenient form of which is shown in Fig. 2 and a sketch showing its use in Fig. 1. The initial conditions of pressure and temperature are found and the total heat is noted. Then, assuming adiabatic expansion, trace along a vertical line downward to the intersection with the terminal pressure and then crosswise to get the total heat. The difference will be the heat drop, which is $(1260 - 852) = 408$ B.t.u.

With a little practice in the use of this diagram any operating man can readily compute turbine efficiency. With formulas and diagrams to compute the heat drop it is a simple matter to compute the Rankine cycle or ideal efficiency by use of the following expression:

E = heat drop ÷ $(H_1 - q_2)$
$= 408.3 \div (1259.6 - 40.3) = 33.5$ per cent.

Applying the first definition for the relative efficiency,

E = actual efficiency ÷ ideal efficiency
$= 21.05 \div 33.5 = 63.0$ per cent.

This is a check with the other method of determination.

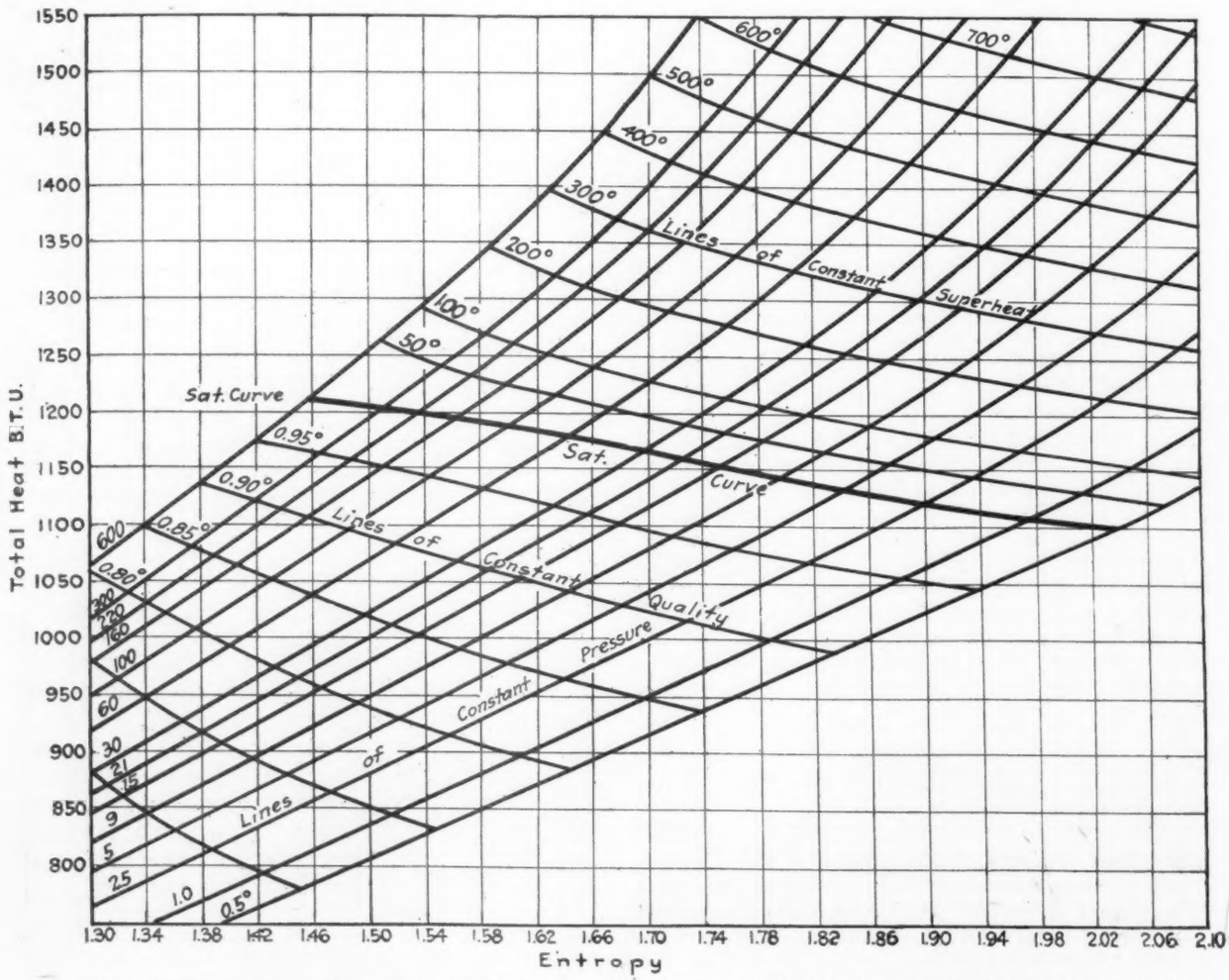


FIG. 2—MOLLIER DIAGRAM FOR USE IN DETERMINING HEAT CONVERTED INTO MECHANICAL ENERGY BY IDEAL ENGINE

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Operating Features of an Illinois Oxygen and Hydrogen Plant

Arrangements to Use Central-Station Energy in the Production of Oxygen and Hydrogen Gas—Methods Adopted to Employ Rotary Converter

Several engineering problems in connection with the operation of a plant for the manufacture of oxygen and hydrogen have been worked out in an interesting way by the Chicago Compressed Gas Company of Clearing, Ill. In contrast with usual practice in gas-producing factories a rotary converter instead of a motor-generator set is employed for changing the central-station energy used for gas-making from alternating to direct current. The rotary converter employed is a 96.8-kw. machine designed to deliver 440 amp. at 220 volts at the direct-current end.

Reasons for Using Rotary Converter

The reasons for adopting the converter as set forth by Fred J. Postel, consulting engineer for the gas company, are as follows: The gas-producing apparatus, after arriving at its normal working temperature, operates at constant voltage, the ideal condition for rotary-converter service. The rotary converter is lower in first cost than a motor-generator set and is also more efficient. In fact, the energy saving effected by the choice of the rotary in this case is 9 per cent. The chief difficulty—that of securing a sufficiently high potential across the cells of the gas machine at starting—was overcome by establishing end-cell connections, which permitted ten cells in each of the two banks of gas-producing cells to be cut out temporarily and later replaced in the circuit as the working cells reached normal operating temperature. A higher voltage per cell during the starting period of the gas machines is made necessary owing to the fact that the resistance per cell is higher when the cells are cold. The end-cell connections enable the operator to cut in the ten end cells in three steps; that is, two steps of three cells each and one step of four cells.

To produce 220 volts at the direct-current end of the rotary an alternating potential of 140 volts was required from the central-station feeders. Special transformers rated at 2200/140 volts were suggested, but to avoid the additional expense of special apparatus for the rotary and of other standard transformers for the gas company's 220-volt alternating-current compressor motors the scheme of connections shown in Fig. 2 was used. On the secondary side of each of three standard 2200/220-volt, 50-kw. transformer taps were taken out at such points in the windings that the potential across the longer leg of each secondary winding was 160 volts. When connected in delta, as illustrated, the taps made it possible to secure a 140-volt, three-phase circuit to feed the converter. With this arrangement it was also possible to operate the 220-volt compressor motor from the same transformer bank. The 110-volt lighting, however, was taken from separate units. In deciding in favor of the standard transformers instead of special apparatus consideration was also given to the fact that in emergencies standard apparatus is more readily obtainable for replacing damaged units.

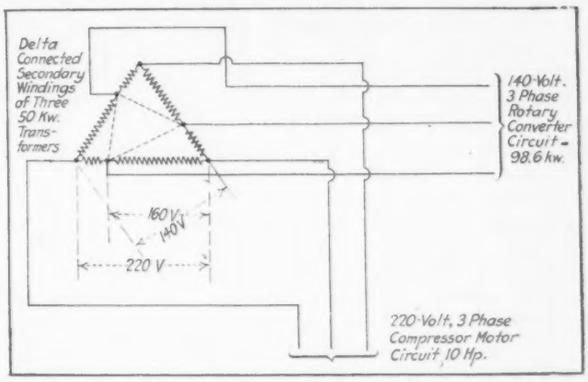

Delta Connected Secondary Windings of Three 50 Kw. Transformers
140-Volt, 3 Phase Rotary Converter Circuit - 98.6 kw.
160 V
140 V
220 V
220-Volt, 3 Phase Compressor Motor Circuit 10 Hp.

FIG. 2—TRANSFORMER CONNECTIONS TO AVOID SPECIAL UNITS

The gas machine itself, which is of German manufacture and which has been shipped to United States through Holland since the European war began, uses for electrolyte a 20 per cent potash solution. This electrolyte, together with the metal electrodes, makes the gas machine in effect a storage battery. If a fuse is blown on the alternating-current side of the rotary, the gas machine could return direct current to the rotary for a short period. A precautionary provision has been made, however, for such occurrences through the use of reverse-current tripping coils on the direct-current circuit-breakers.

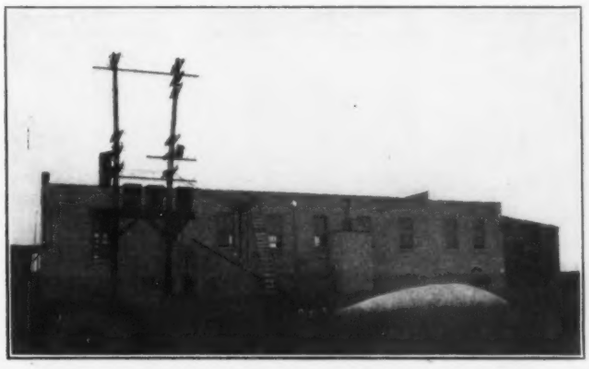


FIG. 1—OXYGEN AND HYDROGEN PLANT AT CLEARING, ILL.

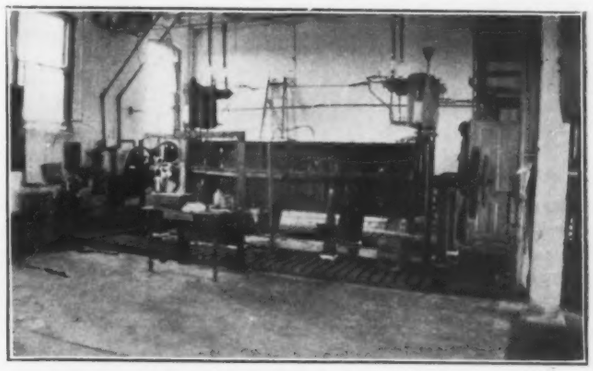


FIG. 3—GAS MACHINE MAKING 7000 CU. FT. OF OXYGEN A DAY

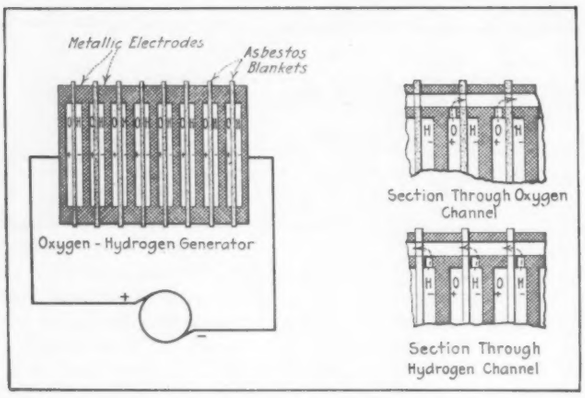


FIG. 4—SECTIONS THROUGH OXYGEN-HYDROGEN GENERATOR

Another electrical contingency which must be guarded against is reversal of polarity in the rotary. If the direction of flow of the direct current were reversed through the gas machine, oxygen would be produced in the hydrogen cells and hydrogen in the oxygen cells, a condition to be strictly guarded against because of the possibility of explosions resulting from such a gaseous mixture. To prevent this catastrophe a voltmeter of the permanent-magnet type equipped with special connections has been placed in the direct-current circuit. When the voltmeter needle moves off the scale to the left owing to reversed polarity the needle short-circuits the special contacts, as shown in Fig. 5, and completes the circuit through the trip coil of the direct-current circuit-breaker. With this breaker open energy cannot be delivered to the gas machine.

At full rating the gas machine used at the Clearing plant produces 7000 cu. ft. of oxygen gas a day. It occupies a floor space measuring only 5 ft. by 15 ft.

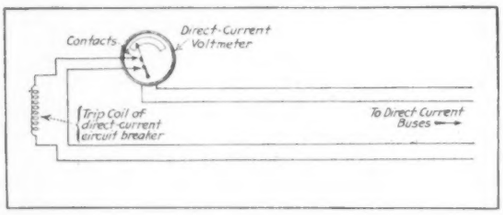


FIG. 5—SCHEME USED TO PREVENT REVERSAL OF POLARITY IN ROTARY

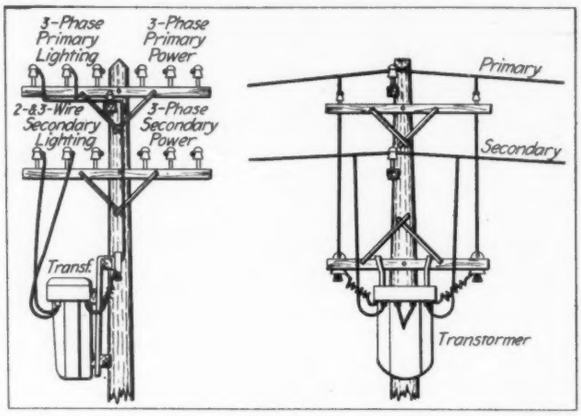
and has a total over-all height of about 6 ft. When operating at full rating it delivers nearly 3 cu. ft. of 99.6 per cent pure oxygen to the balloon containers for each kilowatt-hour of energy delivered to the rotary converter. The machine is made by the Maschinenfabrik Surth and is handled through the Compressed Gas Machinery Company of Buffalo, N. Y.

Low-Down as Against Pole-Top Transformer Mounting

BY PAUL CAPRARO

In the Nov. 13 and the Dec. 4 issues of the ELECTRICAL WORLD descriptions of a portable derrick for handling pole transformers were presented. The writer uses a method of mounting transformers on a pole that does not require the use of a derrick and has other advantageous features, although the installation costs are more than for pole-top mounting. Among the advantages of this arrangement, as shown from the accompanying illustrations, are: (1) Transformers are easily placed in position; (2) no interference from overhead wires; (3) no porcelain knobs are required on cross-arms; (4) fuses are easily replaced without climbing through wires at the top of the pole.

As shown in the drawing, a coil of wire of about twelve turns is used between the transformers and the fuse blocks. Since adopting this practice the blowing



FIGS. 1 AND 2—TRANSFORMER SUPPORT LOW DOWN ON POLE

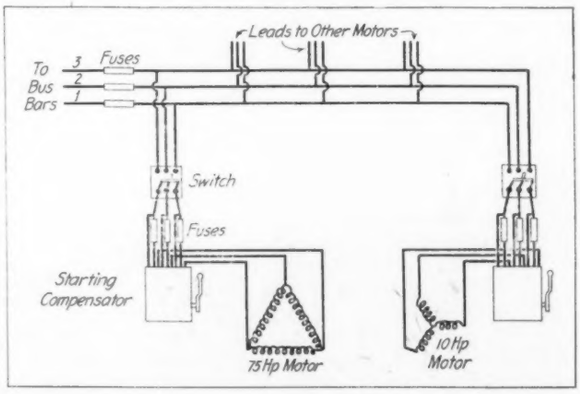
of fuses and transformer burn-outs during lightning storms have been reduced at least 15 per cent. Lightning arresters are, however, also used near the transformers.

Why with One Motor Running Another Failed to Start on Same Circuit

BY A. C. HEWITT

At a Southern industrial plant where 440-volt, three-phase, sixty-cycle energy is used to operate motors of various sizes, an apparently peculiar trouble happened one day when one of three fuses was blown on a feeder circuit. One feeder circuit supplied some four or five motors, one of which was rated at 75 hp. and the others at 10 hp. each. Each motor was equipped with a knife switch, fuses and starting compensator, and the feeder circuit was fused at the distributing switchboard. The 75-hp. motor was delta-connected, while the 10-hp. motors were connected "Y."

The 75-hp. motor was carrying a load of about 50 hp. Only one of the 10-hp. motors was in use, and it was driving a 7-hp. load at the time the trouble developed. Both motors had been running for about four hours when it became necessary to stop the small motor for a few minutes. Upon trying to operate it again it re-



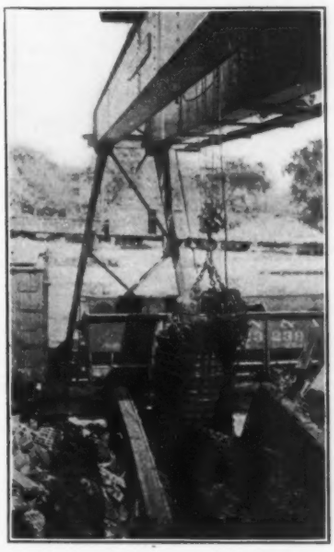
CONNECTIONS FOR MOTORS WHEN 10-HP. MOTOR FAILED TO START

fused to start. The electrician tested the motor fuses with two 250-volt lamps in series, without removing the fuses from the circuit, and found them good. The lamp test seemed to show, however, that the voltage between the middle and either outside wire was not so high as it should be. He then tested the fuses on the 75-hp. motor while the motor was running and found the same conditions as with the 10-hp. motor. Evidently something was wrong, and with reduced voltage between the middle and outside wires it was natural to suppose that there was a high-resistance connection somewhere in that feeder. The large motor was stopped, and the fuses were tested as before, but this time no voltage at all was found between the middle and the outside wires. Then the electrician tried to check up the first results by starting the large motor, but since it was a squirrel-cage three-phase induction motor it would not start on a single-phase circuit.

He next tested the main-feeder fuses and found one of them had blown. A new feeder fuse was put in, and everything started off all right. The reduced voltage between the middle and the outside wires was just one-half of the line voltage, or 220 volts, since the middle wire amounted to a 50 per cent tap on the winding of the large motor when it was running single-phase. This case seemed quite a puzzler at the time, and it was at first thought that the reduced voltage on the middle wire was being generated in the large motor. However, a little study of the conditions soon made plain the real reason as explained.

Arrangements for Loading Scrap Iron by an Electromagnet

An effective use of an electromagnet for handling scrap by the Boston & Albany Railroad at the West Springfield (Mass.) yards is shown in the accompanying illustration. The electromagnet is 43 in. in diameter, weighs 3500 lb., and uses 35 amp. at 250 volts. It is handled by an electric traveling crane of the gantry type, direct-current energy being supplied by a 22-hp. motor-generator set mounted on the crane bridge. The general yard distribution is by alternating current. Rapid transfer of classified scrap is made possible between bins and cars by this equipment. An 8700-lb. steel girder has been successfully handled by the electromagnet shown.

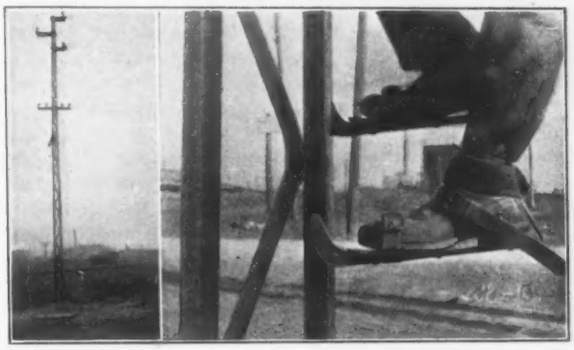


AN ELECTROMAGNET HANDLING SCRAP IRON AT YARDS OF BOSTON & ALBANY RAILROAD

A Way of Climbing Latticed Steel Poles

A new method of climbing latticed steel poles on the lines of a Middle West transmission company is shown in the accompanying illustration. The poles are made up of expanded I-beam sections, and the climbers are designed to engage either of the outer flat sides of the beam.

The climbers resemble the frames of steel hockey skates. On each of the upturned toes two contact points are provided, which grip the steel beam as the weight of the lineman is placed on the shoe. The inner contact



LINEMAN USING STEEL POLE CLIMBERS ON A LINE IN EAST CHICAGO, IND.

point is a conical-shaped projection, while the outer one may be either a partly cylindrical or a square piece of steel with knurled gripping surfaces. With the weight of the climbing lineman at the outer end of the levers, to which these contact points are attached, the climber grips the pole. When the foot bearing the lever is lifted, however, the contact points become disengaged from the pole and the foot may be lifted for another step. This method of climbing steel poles has been devised by the Bates Expanded Steel Truss Company of Chicago.

Is There a Gain in Heat When Burning Watered Coal ?

BY R. I. ELKIN

It is not unusual in a small power plant to see a fireman standing, hose in hand, and wetting the coal. If he is asked why he does it, he will say he does not know, or perhaps that it makes the coal burn better. In the large power station as well the same thing is often done, but here it is not a one man's fancy but a regular routine operation, the train of coal cars being brought under a stream of water. When the large-plant operator is asked why the water is used the answer is little different from that given by the man in the small plant. He may be a little more explicit and say that since water contains hydrogen and oxygen the coal takes the oxygen from the water and liberates the hydrogen, which can thus be burned in the furnace. This may occur under suitable conditions, but the answer does not satisfy the questioner, who desires to know if there is a gain in heat through the practice.

A little common-sense consideration will show that there is no gain in heat; in fact, there is a loss rather than a gain as a result of watering the coal. This must be obvious when it is remembered that the amount of heat required to separate the hydrogen of the water from the oxygen with which it is combined is absolutely the same as that which must be obtained by the complete combustion of the hydrogen in the furnace. From a consideration of this fact it must be apparent that there can be no gain in heat by watering. Not

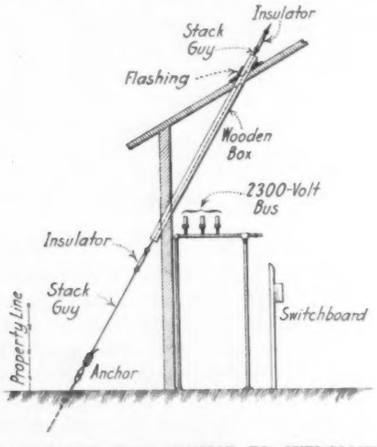
only is there no gain in heat, but if any of the hydrogen is liberated unburned from the chimney, which is quite likely to occur, there must obviously be a loss of heat. There is, besides, a loss of heat irrespective of that due to the escape of unburned hydrogen up the chimney. When the hydrogen is burned it is transformed into water vapor, and in this way the water which has been added to the coal passes up the chimney in the form of steam. The number of heat units required to convert this water into steam at atmospheric pressure and superheat it to the temperature of the flue gases is thus a real heat loss.

Since the practice of watering coal is not apparently followed for chemical reasons, the reason for it is still wanting. Moisture is deleterious in coal as a fuel; it lowers the thermal efficiency of the fire and increases the cost per ton for haulage. It is for these reasons that practically all specifications for the purchase of coal stipulate the maximum percentage of moisture that will be allowed. When coal is damp, however, the very small lumps and particles of dust tend to cling together and form into lumps instead of being blown up into the chimney unburned when fired, as often occurs with forced draft and the high air velocities employed. The issuance of cinders, grit and dust particles from the top of the chimney is not only inefficient, but is unhealthful and annoying to those living in close proximity to the power plant because of the dirt thrown down, and this is about the only logical reason for the wetting of coal. Many central-station firemen claim that dampened coal tends to have less formation of clinker than undampened coal and that the clinker that forms is softer and less troublesome to remove. Perhaps this is true, in which case coal is dampened for physical rather than chemical reasons, and not to gain heat.

It is important to consider further that when chimney gases are liberated direct they have a temperature of 300 deg. and above, whereas when economizers are used and the water supplied them is cold the gases may be cooled down to below 212 deg. In this way the steam in the gases is condensed and its latent heat of evaporation is utilized. Under these circumstances some of the heat required to evaporate the water used for dampening coal is not lost but used. In other words, the presence of economizers raises the thermal efficiency without interfering in any way with the laying of dust particles.

Guying a Stack Under Space Difficulties

The owner of the property adjoining the power house at Coshocton, Ohio, refused to permit an anchor to be set on his land. The power house itself was situated only a few feet from the property line. When it became necessary, therefore, in the process of plant reconstruction, to run a stack guy in the direction of the land owned by the obstinate neighbor, the problem of setting an anchor to hold the guy presented itself. It was finally decided to run the guy through the roof and wall of the power house and attach it to an anchor on the company's own narrow strip of property. The way the guy was incased in a wooden box and run through the power house structure only missing the 2300-volt buses by a narrow margin is shown in the accompanying sketch. The roof around the top of the box was flashed to prevent leaking, and as a further safety measure insulators were placed in the guy wire itself.

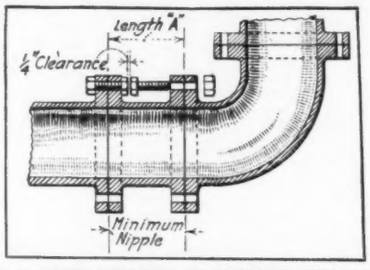


ARRANGEMENT TO SET GUY ANCHOR TO OVERCOME OBJECTION OF ADJOINING PROPERTY HOLDER

Minimum Nipples for Use with Plugged Pipe

BY T. W. REYNOLDS

In laying out a pipe line made up of flanged cast iron, screwed wrought iron or steel sections, it is important from the viewpoint of installation to know the minimum length of nipples that can be used for the different sizes of pipe, both standard and extra heavy. Such data are given in the accompanying table with the minimum length shown as that allowable for the withdrawing of bolts. The length *a* is determined by multiplying the flanged thickness by four, the thickness of the bolt head by two, and the thickness of the nut by one. To this summation is added the clearance of ¼ in., no allowance being made for the slight thickness of gasket between flanges.



LIMITATIONS TO THE LENGTH OF NIPPLES THAT CAN BE USED WITH FLANGED PIPE

The thickness of flanges and the size of bolts given were taken from the American standard schedule, these varying in accordance with the weight of the flanges, either standard or extra heavy. The dimensions on thickness of bolt heads are those given in the manufacturers' standard lists, which are for thickness three-

MINIMUM LENGTH OF NIPPLES FOR DIFFERENT SIZES OF PIPE

Size of Pipe, Inches	Length "A"		Size of Pipe, Inches	Length "A"	
	Standard, Inches	Extra Heavy, Inches		Standard, Inches	Extra Heavy, Inches
2	4 5/16	5 5/16	10	7 3/16	10 1/4
2 1/2	4 9/16	6 1/8	12	7 7/16	11 1/16
3	4 13/16	6 5/8	14	8 1/4	11 9/16
3 1/2	5 1/16	6 7/8	15	8 1/4	12 1/8
4	5 9/16	7 1/8	16	8 1/2	12 3/8
5	5 7/8	7 5/8	18	9 5/16	12 7/8
6	6 1/8	7 7/8	20	9 13/16	13 11/16
7	6 3/8	8 7/16	22	10 5/8	14 1/2
8	6 5/8	8 15/16	24	10 7/8	15 5/16

fourths the diameter of the bolt. A few tables on the weight and dimensions of nuts vary in the thickness for hexagonal and square shapes. In this instance the thickness of the nuts has been taken as equal to the diameter of the bolt. Similarly, some tables on the weights and dimensions of bolt heads vary slightly. The Franklin Institute standard, as devised by William Sellers of Philadelphia, has been disregarded, as the proportions of bolt heads and nuts are not always adhered to. The size of bar required to make a nut is special, and extra work is necessary to make the bolt heads. Under the name of "United States standard," the United States Navy department in 1868 adopted the Sellers system, except for finished heads and nuts, which it made the same as for rough heads and nuts. In some instances, it may be necessary to cut the ends of standard or commercial length bolts to the length desired for use with minimum nipples according to the diagram shown.

Station Rated at 10,000 Kw. Produces Energy at 6 Mills

With a coal cost of $3.67 per ton, tidewater delivery, and a yearly load-factor of 32.4 per cent, the Hathaway Street generating station of the Fall River (Mass.) Electric Light Company produced energy at a net cost of 5.95 mills per kilowatt-hour, according to records for the year ended June 30, 1915, filed with the Massachusetts Gas and Electric Light Commission. This is, of course, only the bare station cost of production and does not include fixed charges or distribution expenses.

For the year cited the total energy delivered at the station buses was 14,005,500 kw.-hr. Twenty men were on the payroll of the plant, and the equipment in brief consists of eight Babcock & Wilcox water-tube boilers of 350-hp. rating each, with four Curtis-General Electric 4000-volt, three-phase, sixty-cycle turbo-alternators having an aggregate rating of 10,000 kw. Two of the latter were 1000-kw. vertical units and two were 4000-kw. horizontal Westinghouse units having Wheeler surface-condensing equipment. The coal was mechanically handled from the barge to the furnace, and each boiler was equipped with a Taylor stoker. The fuel consumption was 14,870 tons of bituminous coal (2.38 lb. per kw.-hr.), and the maximum load was 4925 kw.

Unit operating costs from station performance were as follows:

Coal (0.39 cent per kw.-hr.)	$54,621.48
Oil, waste and packing (0.020 cent per kw.-hr.)	650.02
Water (0.020 cent per kw.-hr.)	2,210.55
Wages at station (0.125 cent per kw.-hr.)	17,430.40
Tools and appliances (0.011 cent per kw.-hr.)	1,557.25
Station-structure repairs (0.050 cent per kw.-hr.)	1,600.26
Steam-plant repairs (0.050 cent per kw.-hr.)	3,386.38
Electric-plant repairs (0.050 cent per kw.-hr.)	2,063.38
Total	$83,519.72

A Result of Cutting Out Series Coils in an Old Design of Alternator

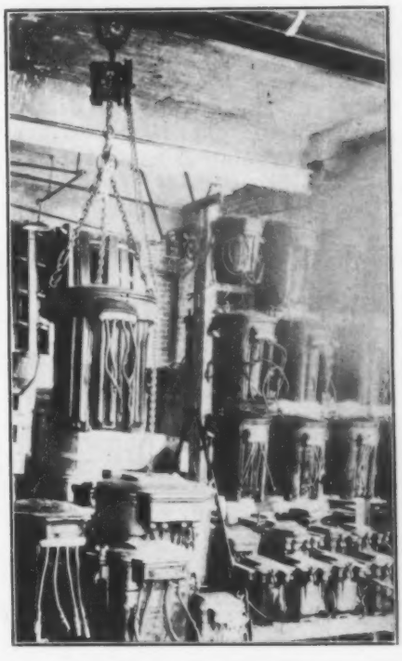
BY E. C. PARHAM

On a compound-wound generator the shunt winding need be only strong enough to permit normal voltage at no load at the maximum temperature at which the machine will operate under working conditions. As the load comes on, the series winding will provide the magnetization necessary to furnish the voltage required by the drop in the winding in the armature and in the external circuit, if the machine is to over-compound. As a matter of fact, the shunt winding always has some margin, and if the shunt field rheostat is entirely cut out, the no-load voltage will be considerably above normal. On a compound-wound machine that is to operate alone it will seldom be necessary to change the field rheostat from its original no-load setting, and any necessity for departing very much from this setting should suggest an irregularity in the field circuit or in the speed.

An operator of an old design of compound-wound alternator complained that the exciter was heating too much. Investigation revealed that lightning had disabled the series winding some time before. Instead of repairing the series circuit the operator had lifted the rectifier brushes and short-circuited the rectifier, thereby cutting out the series winding. This made it necessary to operate the exciter at maximum voltage in order to get sufficient excitation to keep the alternating-current circuit at normal voltage. The increased exciter current heated the exciter armature and the alternator fields which were supplied by it, and the increased exciter voltage heated the exciter-field winding. None of the windings was at a dangerous temperature, but as automatic voltage regulation was a feature to be desired, the machine was "rung out," a grounded field coil located and repaired, and the required exciter voltage thereby reduced from 160 volts to 110 volts. All objectionable heating then ceased.

A Rack for Storing Transformers Compactly

At the service station of the Greenfield (Mass.) Electric Light & Power Company the arrangement shown in the accompanying illustration is used to store transformers. It consists essentially of a framework of



A CHANNEL-IRON RACK FOR STORING SMALL TRANSFORMERS

channel irons, the usual size being 2.5 in. by 2.5 in. by 0.25 in. The central portions of the frame are provided with 5-in. channels to give increased stiffness. In a space 4 ft. 6 in. wide, 7 ft. long and 8 ft. high about seventy transformers are carried in four tiers. The rack is served by a traveling hoist which makes it easy to transfer a transformer to and from the rack. The sizes of transformers carried on this rack range from 600 watts to 3 kva.

"Exposition Jewels," Illuminated by Powerful Projectors, Decked Chicago's Community Christmas Tree

Instead of stringing a maze of wires and small incandescent lamps in the large Christmas tree erected annually on the lake front at Chicago, those in charge of the decoration of the tree this year hung 3600 "Exposition jewels" among its branches and projected light against them. A striking effect was produced, and the tree was pronounced to be the most beautiful that has ever graced the city's lake-front park. Several of the large searchlamps used for the lighting, including one 18-in., one 16-in. and two 15-in. lamps, were placed on buildings across the street from the tree. One 24-in. searchlamp was installed behind the tree and so tipped as to throw its rays up into the evergreen branches. Grouped in a semicircle in front of the tree were twenty-five small flood lamps in each of which was a 1000-watt gas-filled tungsten unit. In the base of the tree, in reflectors which pointed skyward, were about 100 smaller lamps ranging in size from 500 watts to 60 watts. The light from these units was thrown up through the branches of the trees, causing the "novagems" to glitter and sparkle like jewels. Many smaller lamps of various colors were used to light the park. The total connected load of all the tree lighting was 55.92 kw.

MARKETING ELECTRICITY

A Department on Selling Service and Widening the Use of Electrical Energy

Electric Luminous Radiators Replace Gas Logs in Chicago

The sales department of the Commonwealth Edison Company of Chicago has during the last year been able to show the builders of several apartment houses enough points of advantage in the luminous-type electric radiator over the ordinary gas log to effect a sale of about 250 of these devices for fireplaces. The movement started when T. C. Collins, a building contractor, narrowly escaped losing his little daughter, who was suffering from pneumonia. A gas log in her sick-room was being used as an auxiliary source of heat. Since each cubic foot of gas burned required about 8 cu. ft. of air for its complete combustion, the oxygen in the sick room was rapidly becoming depleted when the

LIVING ROOM IN CHICAGO APARTMENT WITH ELECTRIC FIREPLACE FOR AUXILIARY HEATING

physician arrived, ordered the admission of fresh air, and saved the child's life. Mr. Collins thereupon installed electric fireplaces in the next building he erected.

With this story as the basis of a selling argument, other installations were made, and experience has since taught the Edison company that it is really less expensive to wire an apartment building for electrically equipped fireplaces than to lay the pipes for gas, because the gas main, which generally enters at the rear of the building, has to be extended the full length of the structure to reach the usual position of the fireplace. In first cost the luminous radiators are also a little cheaper than the gas logs, although the cost of operation of the former is about 25 per cent greater. Most of the radiators used were of the luminous type. In some cases the portable design has been installed in already-built houses, but where installations were made in new buildings a special design was used. The apartments in which these electric "fireplaces" are installed rent at prices ranging from $500 to $1,000 a year.

Savings Effected by Electric Vehicle Garage Superintendent Through Standardization of Battery Compartments

The desirability of standard battery dimensions for electric vehicles and the uniformity and simplicity of equipment which can be achieved through reconstructing existing battery compartments were pointed out by S. C. Harris of the New York Edison Company in an address before the New York Section of the Electrical Vehicle Association, Dec. 28, when he told of the experience of a large private garage with the diversity of equipment among its vehicles.

In this garage there are 130 electric cars, ranging in size from a two-passenger runabout to a 5-ton truck. The work of assembling this fleet has extended over a period of about twelve years, and almost every make of vehicle is included in it. The delivery service in this particular business requires that extra batteries be kept in reserve so that in emergency work no time may be lost in charging batteries, for often one vehicle is required to do an amount of work in one day equal to the capacity of two batteries. With the aid of reserve batteries the time the vehicle is out of service need only be the time consumed in changing batteries, which is about ten minutes. Eight different designs of vehicles are represented in the fleet, and the number of

cells per battery formerly varied from forty to forty-eight. In no two vehicles of the same capacity but of different designs would the same battery fit when received from the manufacturers. Because of this variation in the dimensions of battery compartments 155 batteries were necessary to operate 120 cars.

When the number of spare batteries had reached this point the superintendent decided to try to standardize the battery compartments where it was possible to do so without too much alteration in the construction of the vehicles. As each machine was taken out of service for a general overhauling the battery compartment was made to agree in shape and size with a standard arranged for the particular group into which it could be made to fit. Since this work was started the battery compartments have been rearranged in sixty-five trucks.

Before overhauling, the number of extra batteries needed for the sixty-five trucks was twenty-four. By the rearrangement this number has been reduced to eleven. The pressure of the charging bus has been lowered 14 volts as the result of reducing the forty-eight-cell batteries to forty-four cells. The amount of space required for reserve batteries is much less, and the mind of the battery man is more tranquil because he now has less bookkeeping to do. The reduction in the investment for spare batteries so far has been $5,000.

Flood-Lighted Lots Sold Rapidly at Rockford

At Rockford, Ill., the use of electric lamps to illuminate a real-estate subdivision at night played a considerable part in the sale of 210 lots within one week. The realty company contracted with the Rockford Electric Company to erect seventy-five poles in the subdivision, with a 60-watt lamp and reflector on each. This illumination attracted a great deal of attention to that section of the city and was directly responsible for getting a large number of people on the ground and hence giving the realty men an opportunity to interest them in purchasing lots. In signing the contract the realty company agreed to use a minimum quantity of energy sufficient to warrant the electric company making the installation.

Shopworn Appliances Given as Premiums on Cash Purchases of $7.50 or Over

With all cash purchases of lamps or appliances amounting to $7.50 or over the Worcester (Mass.) Electric Light Company during Prosperity Week gave an electric appliance worth not over $4 to the customer, who was allowed to select the apparatus from the display in the showroom. In this way a number of appliances which have been improved upon somewhat by later designs, but which were nevertheless in perfect condition and ready for first-class service, were disposed of to the resultant benefit of the meter record.

St. Joseph (Mo.) Central Station Set Pace for Christmas Decorations—Merchants Followed with Street Streamers

A veritable fairyland spectacle greeted Christmas shoppers in the down-town streets of St. Joseph, Mo., as the result of the electric company's setting the example. As its own contribution to the holiday decorations of merchants in the two blocks surrounding its office, the St. Joseph Railway, Light & Power Company strung up streamers of red and green lamps along the curbs and a large sign across the street reading "Merry Christmas." This proved to be such effective advertising that the merchants on the other streets clubbed together and had the same kind of decorations installed in front of their stores.

Special attention was also given by the company to the attractiveness of its show windows, one of which was decorated with a miniature speedway and two tiny electric automobiles running at high speed. A sign on the speedway reading "Hoover wins" referred to the electric-sweeper display on either side of the racing automobiles. The sweepers were arranged to best advantage with Santa Claus in one corner holding a sign reading "Santa's best gift to the housewife."

The pulling power of these well-dressed windows aided materially in making December the biggest month of the year in the sale of electric appliances for the St. Joseph company.

THE ST. JOSEPH (MO.) ELECTRIC COMPANY'S DISPLAY-ROOM TREE, AND THE SPECIAL STREET LIGHTING INSTALLED BY MERCHANTS AFTER THE ELECTRIC COMPANY HAD INAUGURATED THE MOVEMENT BY EQUIPPING TWO BLOCKS NEAR ITS OFFICE

Killing Complaints with Courtesy

Extracts from a Sermon to the Salesmen of the Chattanooga (Tenn.) Railway & Light Company

BY L. J. WILHOITE, CONTRACT AGENT

It is well for every central-station man to appreciate that if he wants to make friends for his company and for himself the best way for him to make progress is to take an active interest in the complaints made to that company by its customers. If he doesn't want to do this, he had better go into some other line of business, for otherwise he will never get very far as a public-utility man. This is true not only of sales-department employees but also of the members of other departments. Central stations are seeking "gentlemanly representatives," and if you don't belong to this class you will never get out of the work all it has to offer. If you are not interested in the grievances of the company's customers, you "don't belong."

It is impossible to formulate a set of rules to follow in adjusting a complaint, because the manner of adjusting must be varied to suit the nature of the fellow with the complaint, and human nature in different "humans" is seldom exactly the same. However, some "dos" and "don'ts"—mostly "dos"—can be laid down that will fit a large number of cases, and in the following paragraphs some of these are set forth with the hope that they will prove of assistance in converting "knockers" into "boosters."

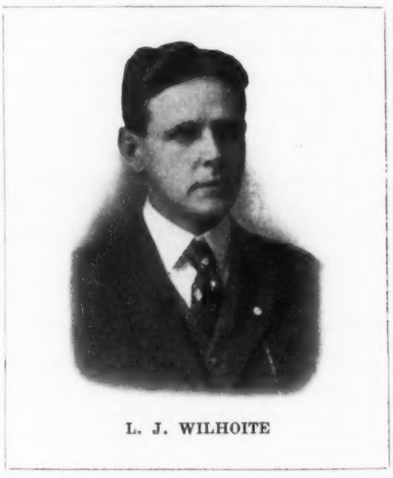
THE PROPER MENTAL ATTITUDE TOWARD THE MAN WITH A "KICK"

In the first place, when a customer comes to you and says, "That bill is too much," never let him get the impression that you think he is a nuisance. And if 'way down inside you feel that he is one, no matter how hard you try to conceal your opinion, he is going instinctively to fathom your feelings, and you will never be able to adjust his grievance satisfactorily. You'll probably get rid of him all right, but he'll go off feeling worse than he did when he came in. The first essential then is for you to "get right with yourself." If a customer's complaint really does exasperate you, and if you can't help feeling that such complaints are nuisances, be honest with yourself and seek employment in a line where you will never have to hear about "high bills"; because if you can't get enjoyment out of trying to convince sincere consumers that your company is treating them fairly and justly, you certainly cannot convince them.

We frequently hear people make the remark: "I think the bills are too high, but what's the use of kicking? They won't do anything about it." This way of looking at the thing is pretty general among a lot of people and isn't wholly unfounded on fact. The central station is in many instances responsible for this feeling on the part of the public, and it's right square up to the men who represent that corporation to kill this popular prejudice by square and honest dealings with all customers and a conscientious, painstaking investigation of every complaint.

The complaint man has two factors to deal with in his work: (1) a preconceived suspicion and prejudice against his company, and (2) a specific instance in which this suspicion has been borne out by apparent facts. In other words, the customer "thought all the time that they would stick him, and now he knows it." It pays to give this fellow as much of your time as he wants, show him some of the difficulties of the lighting business, explain to him how you do things, take him into your confidence, and make him feel that you are interested in him and in his business. Nine times out of ten he'll go away a booster for you and your business, and you can never measure in dollars and cents the value of the influence which that fellow is sure to scatter among his circle of friends and acquaintances.

After all, the word "complaint" is a very unfortunate term to use in referring to a report from a customer that his bill is not right. Such a report should not be considered a complaint, because it isn't a complaint—it is a report from a customer that he has apparently been overcharged. He isn't making a complaint, he's asking for an investigation, and it should be referred to as such and not as a complaint. Do not consider it a complaint. It is wiser and better to look upon it as an opportunity to make a friend for yourself and for your company, and then to take advantage of that opportunity by listening attentively to everything the customer has to say. He'll want to tell you how many lights he has and how long he burns them; how saving he and his wife and family are with electricity; how they always cut off every light when they aren't using it; how they never entertain; how it couldn't possibly be "that much if he turned on every light in the house," and all the many other reasons why his bills ought not to be half as much as they are.



L. J. WILHOITE

LISTENING TO "THE SAME OLD STORY"

It's a little trying at times to sit or stand and listen to all this, because the chances are you have heard the same story a dozen times from others. You may have heard it several times just before he came in, and it is about as entertaining as seeing the same moving-picture show several times during the same day. But remember two things: (1) You haven't heard the story *from him* before. It's new to him, and unless you receive it as a new thing and a matter of importance you'll disappoint him and offend him. No man likes to think that he has been considered a nuisance, especially when he feels his grievance to be just. (2) Also, if you'll listen closely, you'll discover that, after all, his story is not precisely like the other fellow's, because he himself is different and so his story is different. His tale will show his personality, and you'll tell instinctively from his talk and manner what to say to him if you listen and observe attentively.

Examine his bill carefully, ask him the kind of lamps he uses and other questions which are of interest to him, and at the same time throw light on the conditions of his light or motor equipment. Take the ledger and place the whole thing before him; run over his account month by month, checking the readings over with him and explaining to him how the amount of energy used from month to month is determined each time by sub-

tracting the previous readings from the last readings; compare the bill he is complaining about with the bill for the previous month, for the purpose of determining whether or not the meter was correctly read on the previous reading date. Look out for a possible over-reading on the last reading date; compare the bill in question with the bill for the same period of the previous year, explaining carefully in the meantime how and why lighting costs vary with the different seasons and how an incorrect reading of the meter, while causing an abnormal increase or decrease in the amount of the bill affected, will nevertheless adjust itself on the following bill.

USING THE LANGUAGE THE CUSTOMER CAN UNDERSTAND

Remember that all this is new to the customer—that he doesn't understand your business as you do—and explain it all in a courteous way. Never talk in a condescending way, but rather in a plain, frank, open manner that shows sincerity. Don't try to show an air of superior wisdom by talking fluently about "watts" and "kilowatts" and "over-readings" and "under-readings" and "previous readings," or about "so many at 10" and "so many at 6" and "high initial rate" on account of a large "connected load." This stuff is all perfectly clear to you, but remember that the customer doesn't make his living by juggling electricity, and you do, and consequently he doesn't understand all these things, and, besides, he isn't interested in them. Familiarize yourself with the best way to explain these terms to a fellow that knows nothing about them and put it into practice only when it's absolutely necessary.

In other words, do your utmost to control your attitude. At the outset put yourself in the customer's shoes and try to see it as he sees it. It is not necessary for you to tell him that you believe, as he does, that his bill is too big, but, on the other hand, don't try to convince him that it is correct until you have absolutely convinced yourself that it really is correct. You only antagonize him by insisting that his bill must be correct, because *he* honestly believes it isn't, and so it becomes a case of your opinion against his, and he naturally concludes that his knowledge of the case is entitled to more respect than yours. Therefore never hesitate to agree with him that his bill "does seem a little large" and make him feel that if it isn't right it's sure to be made right by you. For, to avoid all prejudice, you must take the position mentally that he takes —namely, that a mistake has been made somewhere in the rendering of that bill and that you and he are working together to find that error. You can do this without compromising yourself or the company, and always the customer will feel that you have, in a sense, become his agent, which is exactly what you are. You are, in fact, a public servant on the payroll of a public utility company, and you represent both your customer and your company, with a duty to both—to see that each renders unto the other that which is due.

Then suppose that you and the fellow with the complaint have by this time become pretty good friends. You have gone over his account with him, explained it to him as best you could, and he has said what he thinks; but one or the other of you, or both, still feel that possibly there is something wrong which your "office investigation" has failed to reveal. Suppose he leaves his bill with you with the assurance that you will investigate further and report your findings to him. When matters have reached this point don't make a haphazard investigation, but get right down to business and dig up the facts in the case. Check the account carefully and look out for the following possible errors: (1) Incorrect meter readings; (2) incorrect transfer of readings from meter-reading slip to ledger sheet; (3) mistakes in calculating the kilowatt-hours consumed; (4) wrong classification of consumer's business, resulting in overcharges on primary rate; (5) wrong primary rate on account of erroneous installation record. If these fail to show any irregularities, secure an investigation of the customer's premises. If possible, go over the ground with the customer, point out to him the lamps that are inefficient and recommend different equipment. Test carefully for grounded circuits, and, if occasion demands, put the meter on test.

But, above all things, avoid all talk of "meter" and "rate." Don't suggest to a man that his meter isn't running right, because 99 times out of 100 it is, and if a customer wants his meter tested he'll tell you. If he doesn't say he wants a test, it's an indication that that phase of things hasn't occurred to him, and for you to bring it up is to start something you may never be able to finish.

But the all-important thing in settling complaints is interest. For if you are interested the thing is three-fourths done.

Wiring a Library for Electric Lantern Projectors

The library of the Boston (Mass.) Society of Civil Engineers has lately been equipped with an electric projector for use in informal illustrated lectures, and the introduction of electric service for this purpose required the provision of two outlets, one of which is shown herewith. The space available was greatly limited, and the desirability of placing the outlets, which are used only occasionally, out of the way was a controlling feature. The outlets have been installed about 24 in. below the ceiling, and the arrangement consists of a two-wire feed carried from an upper-floor branch circuit through 1-in. conduit and condulet outlet to a fuse block holding two 50 amp., 250-volt inclosed fuses and mounted on a 6-in. by 11-in. slate panel carried on a 0.75-in. wooden, asphaltum-treated block 10 in. square. The fuses are separated by porcelain barriers 1.25 in. deep and 0.25 in. thick, and beyond the fuses the leads terminate in a Bryant porcelain receptacle of 25-amp. rating. The receptacle is about 9 ft. 6 in. above the floor.

OUTLET FOR PROJECTION LANTERN IN LIBRARY

Experience with Salesmen's Bonus System

John M. Bruce, one-time sales manager of the American Tobacco Company, related an experience before the Executives' Club of Chicago that should interest all sales managers employing bonus systems. He said:

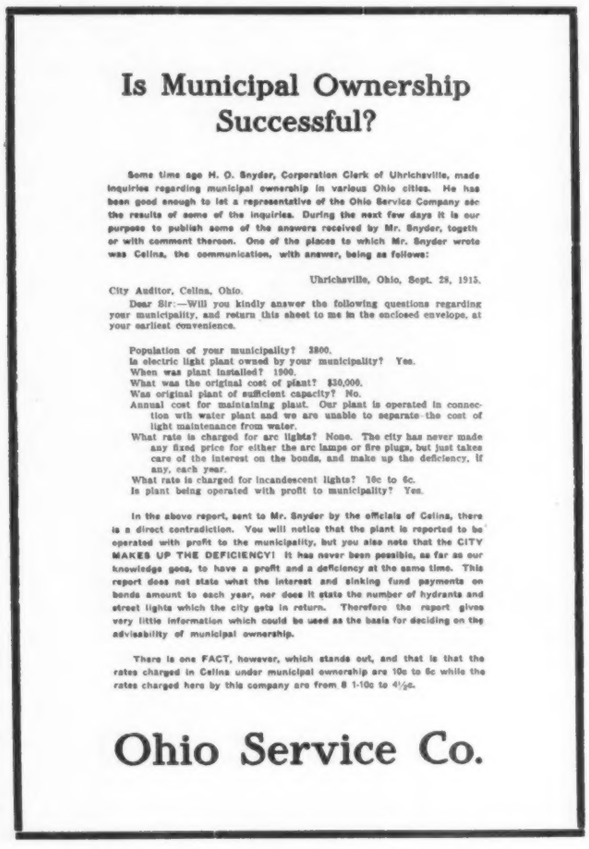
"I used to give our men a raise in wages at the end of the year, provided that a certain mark was reached in their sales. I checked up the results of about 500 men. I found that the record of the eleventh month made an abrupt climb upward. Then I tried checking up at the end of the month. I found that the fourth week showed the same symptoms as the eleventh month. Then I

analyzed the week, with the same results, and then the day, and I found that the men did three times as much work in the afternoon as they did in the morning."

In other words, the natural ambition to make a record and a bonus for the day, the week, the month, the year brought a powerful stimulus that resulted in far greater achievement.

Publicity Campaign of Ohio Service Company Contrasts Electric Rates Under Municipal and Private Operation

An interesting publicity campaign has just been completed for the Ohio Service Company at Uhrichsville, Ohio. The problem was to conduct a general good-will campaign and at the same time to present authoritative information regarding municipally owned electric plants in the State of Ohio. The general impression had existed, without any information in the hands of the public on which to base it, that the rates of the Ohio Service Company were too high and that municipal ownership might offer a means of securing reduced rates.



Is Municipal Ownership Successful?

Some time ago H. O. Snyder, Corporation Clerk of Uhrichsville, made inquiries regarding municipal ownership in various Ohio cities. He has been good enough to let a representative of the Ohio Service Company see the results of some of the inquiries. During the next few days it is our purpose to publish some of the answers received by Mr. Snyder, togeth er with comment thereon. One of the places to which Mr. Snyder wrote was Celina, the communication, with answer, being as follows:

Uhrichsville, Ohio, Sept. 28, 1915.

City Auditor, Celina, Ohio.

Dear Sir:—Will you kindly answer the following questions regarding your municipality, and return this sheet to me in the enclosed envelope, at your earliest convenience.

Population of your municipality? 3800.
Is electric light plant owned by your municipality? Yes.
When was plant installed? 1900.
What was the original cost of plant? $30,000.
Was original plant of sufficient capacity? No.
Annual cost for maintaining plant. Our plant is operated in connection wth water plant and we are unable to separate the cost of light maintenance from water.
What rate is charged for arc lights? None. The city has never made any fixed price for either the arc lamps or fire plugs, but just takes care of the interest on the bonds, and make up the deficiency, if any, each year.
What rate is charged for incandescent lights? 10c to 6c.
Is plant being operated with profit to municipality? Yes.

In the above report, sent to Mr. Snyder by the officials of Celina, there is a direct contradiction. You will notice that the plant is reported to be operated with profit to the municipality, but you also note that the CITY MAKES UP THE DEFICIENCY! It has never been possible, as far as our knowledge goes, to have a profit and a deficiency at the same time. This report does not state what the interest and sinking fund payments on bonds amount to each year, nor does it state the number of hydrants and street lights which the city gets in return. Therefore the report gives very little information which could be used as the basis for deciding on the advisability of municipal ownership.

There is one FACT, however, which stands out, and that is that the rates charged in Celina under municipal ownership are 10c to 6c while the rates charged here by this company are from 8 1-10c to 4½c.

Ohio Service Co.

ONE OF THE NEWSPAPER ADVERTISEMENTS

The first few advertisements in the local newspaper campaign, which was conducted by Glenn Marston, dealt with the facilities that had been provided by the company for giving an unusually high character of service. The next "copy" showed the evils of competition, whether by a municipal plant or by another private company, and, lastly, the series dealt with the facts regarding municipal plants. Mr. Marston had personally examined the accounts and physical property of many Ohio municipal plants, and was able to supply information which had been omitted from reports furnished by officials connected with the various municipal plants addressed by the Uhrichsville authorities in an attempt to secure comparative data.

An analysis of the rates and service conditions of seventy-six municipal plants in Ohio disclosed some interesting facts. Practically every one of the municipal plants, according to Mr. Marston, is being operated at a deficit, if proper fixed charges are included and proper credits are made for street lighting and hydrant rental. It was shown that thirty-seven plants charged higher rates for 100 kw.-hr. a month than were charged by the Ohio Service Company, four charged the same price, and twenty-seven charged less. The remaining plants serve street-lighting systems only. The average price per kilowatt-hour for the first 100 kw.-hr. from the seventy-six plants on which information could be obtained was 7.3 cents per kilowatt-hour, while the price in Uhrichsville from the Ohio Service Company was 7.2 cents. In plants charging less than this amount, when the deficits were added to the cost of operation, the actual cost per kilowatt-hour was in all cases higher than 7.2 cents, and in one case as high as 64 cents per kilowatt-hour. It was also brought out that about half the municipal plants in Ohio operate only six to twelve hours a day, as compared with the continuous twenty-four-hour service of the Ohio Service Company.

Near the close of the publication of the series of advertisements the chairman of the local lighting committee stated that he did not think it would be possible for some time for the city to secure enough information to justify a decision as to whether the people should be asked to vote on issuing bonds for a municipal plant.

Tungsten Lamps Solve Difficulty in Zinc Ore Cleaning

The use of gas-filled tungsten lamps has been found to be most successful in the process of cleaning zinc ores, where by ordinary lamplight it is very difficult to distinguish between the "black jack" (dark zinc ore) and lead, as they appear about the same color. Under the white light of the gas-filled lamp the two ores are readily distinguishable, however, and practically all the zinc refineries are now installing 750-watt and 1000-watt lamps for this purpose.

Proving the Value of Long-Hour Display Lighting

Speaking on electrical advertising before the salesmen of the Ohio Electric Light Association, W. A. Wadsworth of Cincinnati said he knew of a merchant who for years had followed the practice of turning out his window lamps when he closed his store. This man was finally induced to try the experiment of leaving the lamps in operation until 11 o'clock every night for a month. It was necessary for the central station to loan the lamps and reflectors and to donate the energy for this period, but the company was willing to do this since the merchant was established on a street with heavy night traffic and it was thought that his example would be followed by his neighbors.

As a result of this experiment the merchant bought the window-lighting equipment and placed his window lighting on a midnight schedule. Furthermore, he employed some moving feature, usually electrically operated, in every window trim. He has since then entirely remodeled his interior lighting, replacing gas arcs with gas-filled electric units, and has offered to use the best exterior electrical advertising suggestion made him that will not call for an expenditure of more than $500.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

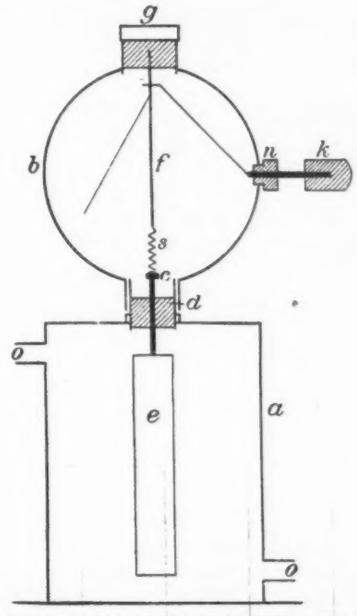
Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Production and Use of Radium

Successful Work of the United States Bureau of Mines on the Extraction and Recovery of Radium, Uranium and Vanadium from Colorado Carnotite

OF all the brilliant physical, chemical and physico-chemical researches of the last decades none has been more fascinating and fundamentally far-reaching in scope than the study of the phenomena of radioactivity. While former generations regarded the atom as the smallest indivisible particle of matter and differing chemical elements as fundamentally different, non-interchangeable kinds of matter, the facts of radioactivity have taught us that there is such a science as the "anatomy of the atom," that there is such a thing as transmutation of elements, and that in the last analysis matter is made up of electrons.

The study of radioactivity in Europe has been based on radioactive substances extracted from pitchblende,



ARRANGEMENT OF MODIFIED EMANATION ELECTROSCOPE

while in this country Colorado and Utah carnotite has been the one mineral most promising as the starting point for such researches. Besides one private company which has been largely interested in carnotite treatment, the United States Bureau of Mines in co-operation with the National Radium Institute has carried out extended researches during the last three years under the direction of Dr. Charles L. Parsons. These have now been carried to a successful outcome, and on Dec. 17, 1915, Dr. Parsons lectured in the Chemists' Club of New York before the New York Section of the Society of Chemical Industry on the results of this work. While this lecture was made particularly interesting by the exhibit and demonstration of samples of radioactive substances, the methods of the recovery of radium from carnotite have since been described very fully in Bulletin 104 of the Bureau of Mines, entitled "Extraction and Recovery of Radium, Uranium and Vanadium from Carnotite," by Charles L. Parsons, R. B. Moore, S. C. Lind and O. C. Schaefer.

The enormous difficulty of the problem will be appreciated from the fact that one part by weight of radium has to be extracted from some 200,000,000 parts of ore. The capacity of the plant of the Bureau of Mines and the National Radium Institute is 3.5 tons per day, and up to Oct. 10, 1915, nearly 5 grams of radium were extracted and approximately 2.5 grams of element were delivered in the form of radium bromide, of such degree of purity as desired by the two hospitals concerned (the Kelly Hospital in Baltimore and the General Memorial Hospital in New York), some also being supplied to the hospital of the Army, Navy and Public Health Service. "With ore obtained from government land or produced at a cost as low as that maintained in the operations of the bureau, it has been shown that the cost of producing radium need not exceed $40,000 per gram and that the extraction of at least 90 per cent of the radium present may be obtained from good-quality ore, such as the bureau has been able to procure." The market price of radium for some two or three years has been $120,000 and up per gram of element, according to the purity. "As to the selling price of radium in the future, the bureau makes no prediction, but it does not follow that the selling price will decline because of the development of cheaper methods of production. . . . It is highly improbable that the variety of uranium ores will ever be greatly modified, so that the price of the finished material will largely depend on the ability to procure the raw material." The essential principle of the bureau's method of treatment is leaching of the carnotite ore with hot nitric acid. The final product of the first step is precipitated radium-barium sulphate. This is reduced with carbon to sulphide, which by treatment with hydrochloric acid is changed to radium-barium chloride. By fractional crystallization barium chloride is separated from radium chloride.

From the standpoint of the electrical engineer radium measurements are especially interesting. By electrical methods of measurement radioactive elements can be detected and even quantitatively measured in quantities far below the limits of any methods based on other properties. It is this very property more than any other which has made possible the concentration of an element from an ore containing about one part in 200,000,000 by weight to a product of any desired purity up to 100 per cent, with a total loss not exceeding 15 per cent. Three general methods of radium measurement may be used—first, an alpha-ray method suitable for solids of low radium content, where no great degree of accuracy is desired; second, a gamma-ray method suitable for solids with a comparatively high radium content, where accuracy is desired, and, third, an emanation method, suitable to any substance from which the radium emanation can be quantitatively liberated and in the use of which an accuracy of 1 to 2 per cent is obtainable.

In the work of the Bureau of Mines a modified form of the aluminum or gold-leaf electroscope of the C. T. R. Wilson type (see diagram) has been found entirely satisfactory for all quantitative purposes. The chief

modification consisted in making the upper part of the instrument carrying the telescope and leaf system separable from and interchangeable with a large number of gas-tight ionization chambers. The emanation chamber is a gas-tight brass cylinder *a* with plain brass outlet tubes *o* to which connection is made by rubber tubing to glass stop-cocks. The electrode *e* is a brass cylinder, which screws into the top of the electrode, passes upward through the insulating material *d*, and terminates in a small conical cap *c*, serving to make metallic contact with the leaf system above. The leaf system *f* is supported from the top of the cylinder, where it is held in place by sealing-wax insulation set in a milled-head cap *g*, which screws into a vertical collar on the cylinder. The cap is hollowed out inside to contain the insulating wax, from which a flat brass rod *f* projects downward, terminating below in a light brass spring *s*, to make a slight contact with the conical top of the electrode of the ionization chamber. The spring should touch the electrode lightly or it will throw the leaf system out of position. The aluminum leaf itself is attached to a small offset at the top of the brass rod by a moisture contact. The whole leaf system may be removed by unscrewing the cap without disturbing the rest of the instrument. The charging device *k* consists of a brass rod threaded horizontally through a hard-rubber insulation *n* in the side of the case. Inside the case the rod slopes upward at an angle of 45 deg. and then extends horizontally, so that contact can be made with the brass rod of the leaf system while being charged, or so that it may be turned and grounded against the wire grating of the outer case. The leaf system and telescope are carried by the upper part of the instrument and have the advantage of being fixed in a perfectly rigid position with respect to each other. The ends of the horizontal cylinder *b* containing the leaf system are closed by sheet mica. A glass tube fixed in the wooden base of the instrument serves to hold a small sealed tube of radium salt used in controlling the calibration of the instrument. A suitable quantity of radium (about 1 milligram of element in a sealed tube) furnishes a constant source of penetrating radiation, which may be conveniently employed to control the calibration by measuring the rate of discharge when this tube is placed in the glass tube fixed into the base, and by making comparison with the discharge obtained in the same way at the time of calibration with emanation.

The principle underlying the use of the emanation electroscope is that in a given discharge chamber containing at two different times different quantities of radium emanation the ionization and consequent rate of discharge will be proportional to the quantity of emanation present. If in one case this quantity is known, the unknown quantity can be determined by a direct comparison of the two rates of discharge. The principle seems simple and with the observation of a few essential precautions is really so in application.

Generators, Motors and Transformers

Heating of Electrical Machines.—J. Guttmann.—An article giving in a table a comparative summary of the different regulations in force in Germany and Austria concerning the permissible heating of the windings, commutators, iron parts and bearings of dynamo-electric machines.—*Elek. u. Masch.* (Vienna), Aug. 29, 1915.

Three-Phase Generators.—An illustrated description of three-phase generators built by a Norwegian company for the Rjukanfos power station. They are to be used for supplying energy to Birkeland-Eyde furnaces for the fixation of atmospheric nitrogen and are believed to be the largest three-phase generators built for direct coupling to water turbines. The output of each generator was fixed at 19,800 kva., 9500 volts, fifty periods, power-factor 0.65 as the maximum continuous rating. The speed of the sets is 250 r.p.m. Curves show results of tests.—London *Electrician*, Dec. 10, 1915.

Dispersion Coefficient of Induction Motors.—E. A. Biedermann.—A continuation of his long mathematical article on the estimation of the dispersion coefficient of three-phase induction motors and its application to their design. The author separates the dispersion coefficient into three components, termed the main, the peripheral, and flank dispersions. In the present installment the author discusses the calculation of peripheral dispersion with semi-inclosed slots.—London *Electrician*, Dec. 10, 1915.

Lamps and Lighting

Metallic Filament.—A note on a recent British patent (No. 22,057, 1914) of E. R. Grote and W. H. Reynolds for a binder for making tungsten filaments by the squirting process, consisting of gelatinous aluminum hydrate in conjunction with a solution of tungsten acid or other tungsten compound.—London *Elec. Eng'ing*, Dec. 9, 1915.

Color Mixtures.—H. E. Ives.—A mathematical paper illustrated by diagrams in which the author discusses how measurements on one trichromatic system can be transformed to another system, and how measurements on any trichromatic system can be transferred to the monochromatic system, and vice versa.—*Journal Franklin Inst.*, December, 1915.

Generation, Transmission and Distribution

High-Pressure Underground Distribution Systems.—J. R. Beard.—A long illustrated abstract of a paper read before the (British) Institution of Electrical Engineers on the design of high-pressure three-phase distribution systems by underground cables. After notes on underground mains and switch gear, the author deals with the economical section of mains. Although it is generally known that the economical cross-section of a main is that at which the sum of the annual charges and the value of the energy lost is a minimum, it is seldom that any practical use is made of the formula. The author shows that for high-pressure distribution

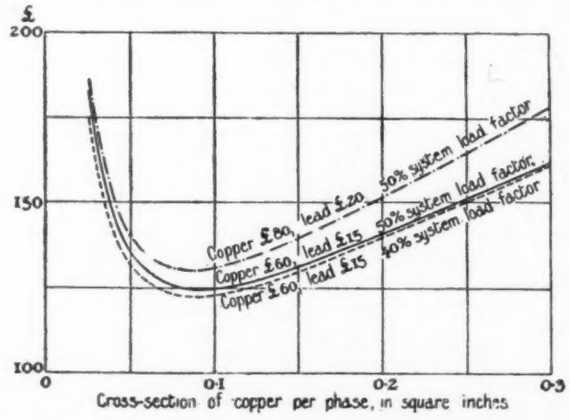


FIG. 1—COMBINED ANNUAL COST OF INTEREST, DEPRECIATION AND ENERGY LOSSES PER MILE

systems the formula appears to give commercially useful results. By adding the curves of annual charges and value of losses for mains of various sizes for any particular maximum current a curve is obtained of the type shown in Fig. 1, which refers to a 6000-volt underground cable required to deal with a maximum current of 100 amp. The most interesting feature of this curve

is that the most economical section is not very definite; it is actually 0.09 sq. in., but for 2.5 per cent increase in the total annual costs the section can be increased 44.5 per cent, or decreased 27.2 per cent, the corresponding figures for 5 per cent increase in annual costs being 65.5 per cent and 36.1 per cent respectively. It follows that it is not sound practice to cut the section of mains too fine, more especially since it is a most ex-

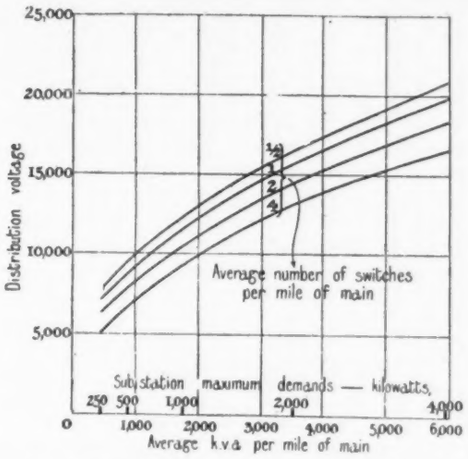


FIG. 2—ECONOMICAL DISTRIBUTION VOLTAGE

pensive matter after a main is once laid to increase its carrying capacity if this should prove too small. The author then discusses the layout of the distribution system. For the protection of substations some form of discriminating protective device must be installed in each feeder, and a fault on one feeder must not interfere with the supply through a sound feeder. The balanced-current protective system with pilot wires and the split-conductor protective system are the only forms of protection which meet these conditions. They increase the cost per mile of main of a given section, but this is counterbalanced by the possibility of using an interconnected system allowing of (a) reduction in cost of mains due to the saving in spare feeders, (b) reduction in cost by using a few large feeders instead of many small ones, (c) reduction in amount of switchgear, and (d) reduction in the total annual cost of mains owing to the effect of diversity factor. The author compares the following three types of distribution systems: (1) An interconnected system equipped with balanced current or split-conductor protection of a fault on a feeder; (2) a simple radial system with duplicate feeders direct from the power station to each substation, equipped with time-limit overloads at the power station end and reverse-power relays at the substation end; (3) a series radial system with duplicate feeders to each substation protected as in (2) but with direct feeders from the power station to only half the substations, each of these in turn feeding one of the remaining substations. For the purpose of the comparison a typical case is assumed of an area of 25 square miles with the power station at the center and a substation with a maximum load of 500 kw. at 0.8 power-factor and a load-factor of 30 per cent situated at the center of each square mile, the distribution being effected by underground mains at 6000 volts. The result of this comparison is that the annual cost of the simple radial system (2) and that of the series radial system (3) are 61 per cent and 28 per cent higher respectively than the annual cost of the interconnected system (1). This is the result for 6000 volts. Speaking generally, the higher the system voltage the greater is the economy to be obtained by interconnection. For discussion of the most suitable distribution voltage for underground mains, the author considers a system comprising twenty-four substations evenly spaced and allowing an average of two and one-half switches per substation for controlling the step-down transformers. The total annual cost of switch-gear and mains is calculated for various distribution voltages and various substation loadings. In addition, the spacing of the substations is also varied so as to give several comparative proportions between the number of switches and the mileage of mains. From these results the series of curves given in Fig. 2 are plotted, showing the most economical voltage under the varying conditions. As might be expected, Fig. 2 shows that the heavier the loads to be supplied and the more they are concentrated the higher is the most economical voltage. The curves show no signs that at 20,000 volts the maximum economical voltage has been reached, provided the system loading is heavy enough, and hence for the larger systems of the future we may expect that for economical reasons alone the distribution voltage will be raised above 20,000 volts. These calculations refer only to underground mains; with overhead mains the economical voltage will be higher, since there is so little difference between their cost at various voltages.—London *Electrician*, Dec. 17, 1915.

Installations, Systems and Appliances

British Central-Station Account.—An abstract of the last annual report of the St. Marylebone electric central station for the year ended March 31, 1915. Altogether 22,547,171 kw.-hr. was generated, of which 15,926,167 kw.-hr. was sold, against 17,038,516 kw.-hr. the year before, so that there is a decrease of 6.35 per cent, chiefly due to the lighting restrictions imposed by the British authorities. The cost of fuel has increased. The number of consumers was 10,175, against 9755 the year before. The average price, excluding the meter rent, was 5.18 cents against 5.16 cents. The total cost excluding capital charges per kilowatt-hour sold was 2.22 cents, against 2.12 cents the previous year, and the total cost including capital charges was 5.80 cents, against 5.38 cents. The total revenue was 5.58 cents, against 5.50 cents. Therefore, while there was a profit balance of 0.12 cent per kilowatt-hour sold in the preceding year, there was a deficit balance of 0.22 cent during this year.—London *Electrician*, Dec. 17, 1915.

Telegraphy, Telephony and Signals

Submarine Cable Rapid Telegraphy and Ocean and Intercontinental Telephony.—BELA GATI.—In this paper, which was presented before the International Engineering Congress in San Francisco, the author enumerates the tendency and researches with reference to improvements in both cable telegraphy and long-distance telephony. The various cable relays are discussed, as also are the attempts with the high-frequency system on ordinary cables. The theory of the resistance of the cable is given, and different cables are taken into computation. The problem is nearly the same also for ocean telephony. For connecting continental circuits strong current microphones, more sensitive receivers, improved single-wire loaded circuits and telephone relays can be applied.—London *Electrician*, Dec. 3, 1915.

Wireless Telephony.—AUGUST HUND.—The author gives an illustrated review of the research work carried out by Langmuir, Dushman, Alexanderson, White and Hund in the research department of the General Electric Company on the development of "a new system of wireless telephony." The principle and use of the pleiotron as a relay for wireless telephony is first discussed and the arrangement of the wireless telephone system is then outlined.—*Elek u. Masch.* (Vienna), Oct. 31, 1915.

Book Reviews

FORD METHODS AND THE FORD SHOPS. By Horace Lucien Arnold and Fay Leone Faurote. New York: The Engineering Magazine Company. 440 pages, illustrated. Price, $5.

It is said that size makes a universal appeal in America. If a thing is the biggest of its kind it immediately gets an audience. This is at least one factor in the general interest in the Ford plant at Detroit. Quite apart from the material on detail methods embraced in this book, many engineers and managers in the electrical industry will find a very real interest in a consideration of how mere size alone affects methods. This one tremendous lesson of the Ford plant at the same time is a limiting factor in the universal application of the methods described with such care in the book. Few other engineers or manufacturers may adopt them in detail. But at least the book is full of suggestions and well worth the consideration of every engineer whose work brings him into contact with manufacturing and industrial operations. In this respect the book transcends its authors and gets its interest and value more from the "personality of the Ford plant." The material in the book was first published in the *Engineering Magazine* as a series of articles started by Horace L. Arnold. Mr. Arnold died in the midst of his task, and Fay Leone Faurote finished the series. Charles B. Going has managed and edited the material so that the book has a unity which, because of the circumstances, was not the case as the articles were published. The book runs to nearly 500 pages in length and contains scores of photographs of detail operations which aid materially in making its contents useful as well as interesting.

THE MECHANICAL ENGINEERS' POCKET-BOOK. By William Kent. A Reference Book of Rules, Tables, Data and Formulas. Ninth edition, thoroughly revised with the assistance of Robert Thurston Kent. New York: John Wiley & Sons, Inc. 1526 pages, 250 illus. Price, $5.

Professor Kent's handbook is one of the best known and most used reference books of its kind, a reputation gained by the extremely practical nature of the material it contains and its accuracy. The ninth edition has just been issued, with revisions in 400 pages of the eighth edition and with 150 pages of new material added. Extensive revisions in the mechanical section are noticed under the headings of steam boilers and engines, fans and blowers, heating and ventilation, and machine shop. Under the last heading seventy-five pages are now given, as against forty-five in the eighth edition. Under the heading of steam boilers and engines up-to-date data on boiler testing are given with directions according to the 1915 A. S. M. E. boiler code, also rules for conducting engine tests from the 1915 code of the A. S. M. E. power test committee. Five pages have been added to the steam-turbine section giving data on turbine tests, a discussion of the Rankine cycle and Rankine efficiency, effects of pressure, vacuum and superheat on efficiency, and data on steam consumption for new and large installations. Additional material is also given on the work of air pumps and the economical vacuum for a turbine. New material also appears on air supply for cooling towers, water-evaporated, with several tables. The most extensive revision of the handbook is found in the section devoted to electrical engineering. The author acknowledges the assistance in this work of David B. Rushmore, consulting engineer of the General Electric Company. This part of the book has been completely rewritten and much material added. The section on electric transmission has been greatly improved, and material under the heading of electric railways has been added, including data to show the relative efficiencies of different railway distribution systems. The subject of electric welding, to which less than a page was given in the eighth edition, now takes up more than twice the space, with data on energy required and cost of welding. Electric heating and electric furnaces, which had a little more than two pages in the last edition, now take up nearly five pages, with steam-generating and room-heating requirements given. Less descriptive matter appears under electric furnaces in the new edition and more useful information on operating characteristics and uses, with data on refining steel and on costs. Under the heading of dynamo-electric machines three pages of useful information and data on rating, temperature and limitations of capacity are given, all new material, first printed in the ninth edition. Ten pages of material on alternating-current generators, transformers, synchronous converters and motor generators are new and give data on rating, efficiency, regulation and operation. Characteristics of motors affecting their application are included as taken from the section by Mr. Rushmore in the "American Handbook for Electrical Engineers." Many of the old data on motors and generators have been discarded. The subject of illumination has been moved to the end of the book and considerably expanded, giving illumination data and characteristics of the latest lighting units. A slight type change has been made in the index which has greatly improved its service to the user of the book. Each of the section or subject headings has been set in a distinct boldface letter which makes it possible to locate the subject looked for under this heading very easily and quickly.

Books Received

Inventions and Patents. By Philip Edelman. New York: D. Van Nostrand Company. 288 pages. Price, $1.50.

Die Funkentelegraphie. By H. Thurn. Leipzig and Berlin: B. G. Teubner. 112 pages, 51 illus. Price, 1.25 marks.

Safety Engineering Applied to Scaffolds. Hartford, Conn.: The Travelers Insurance Company. 354 pages, 127 illus. Price, $3.

Arithmetic of Electricity. By T. O'Conor Sloane. New York: The Norman W. Henley Publishing Company. 160 pages. Price, $1.

Beitrag zur Berechnung von Mastfundamenten. By Dr. Ing. H. Frohlich. Berlin: Wilhelm Ernst & Sohn. 60 pages, 61 illus. Price, 2.60 marks.

The Telephone and Telephone Exchanges. Their Invention and Development. By J. E. Kingsbury. New York: Longmans, Green & Co. 558 pages, 170 illus. Price, $4.

Overhead Transmission Lines and Distributing Circuits: Their Design and Construction. By F. Kapper. New York: D. Van Nostrand Company. 300 pages, 397 illus. Price, $4.

Power for Profit. Principles Governing the Use of Machinery and Labor in Modern Buildings. By Reginald Pelham Bolton. New York: The DeVinne Press. 210 pages. Price, $2.50.

Principles and Practice of Cost Accounting for Accountants, Manufacturers, Mechanical Engineers, Teachers and Students. By Frederick H. Baugh, Baltimore, Md.; published by the author. 194 pages. Price, $3.

C. P. SPARKS

Charles P. Sparks, the new president of the British Institution of Electrical Engineers, succeeding Sir John Snell, is engineer-in-chief to the County of London Electric Supply Company, the metropolitan central-station organization which supplies service over an area covering nearly 200 sq. miles in the city of London. Mr. Sparks was associated with Mr. S. Z. de Ferranti in the development of his system of high-pressure distribution with transformers, first becoming a partner of the firm with Mr. Ferranti and Francis Ince in 1887. Prior to 1891 Mr. Sparks took a leading part in the erection of the Grosvenor Gallery lighting station and the famous Deptford plant, leaving, however, in 1891 to become works manager for the Ferranti company, in which position he continued until his return as chief engineer of the County company. Since 1899, with his brother, Captain H. C. Sparks, the president-elect has conducted a consulting-engineering business and has supervised the erection of electric power plants for collieries, metal mines and mills in Great Britain, India and the British colonies, and in the United States.

Bernard Lester has been appointed manager of the small-motor section of the industrial department of the Westinghouse Electric & Manufacturing Company.

R. Y. Conklin has assumed temporary charge of the Daytona (Fla.) Public Service Company for the winter months, succeeding Ira A. Blalock as manager.

W. S. Hanbridge, secretary-treasurer of the California Association of Electrical Contractors and Dealers, has resigned to enter private practice and will be succeeded by James Redpath.

John L. Harper, chief engineer for the Hydraulic Power Company, Inc., of Niagara Falls, N. Y., has been appointed supervising engineer of the Niagara Falls Grade Crossings Commission.

F. H. Brooks, formerly manager of the Red Oak Electric Company at Red Oak, Iowa, has purchased an interest in the Mid-West Electric Company of Omaha, Neb., and will take up his residence in that city.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Charles A. Stone, president of the American International Corporation, New York, and a member of the firm of Stone & Webster, Boston, Mass., has been elected president of the alumni council of the Massachusetts Institute of Technology.

Maurice Sarbinsky, for several years secretary of the city department of public utilities at Cleveland, Ohio, has been appointed president of the Service Electrical Company of Cleveland, recently incorporated to do an electrical contracting business.

H. A. Steen, who for the past eight years has been manager of the Custer Electric Company at Broken Bow, Neb., has been appointed manager of the Red Oak Electric Company at Red Oak, Iowa, to succeed F. H. Brooks, who has resigned to start in business.

W. D'Arcy Ryan, illuminating engineer of the General Electric Company and chief of illumination at the San Francisco Exposition, has been retained by the corporation of Salt Lake City, Utah, to carry on special work in connection with a new city street-lighting system. Mr. Ryan is at present engaged in street-lighting work for the city of San Francisco.

William K. Vanderpoel, who had been division superintendent of distribution for the Newark (N. J.) district of the Public Service Electric Company, was on Jan. 1 appointed general superintendent of distribution for the entire Public Service system in New Jersey. Mr. Vanderpoel's new headquarters will be at the main office of the company at Broad and Bank Streets, Newark.

Ell C. Bennett, Mercury of the Jovian Order, St. Louis, Mo., is receiving the sympathy of his friends upon the death of his mother, Mrs. Julia M. Bennett, a noted woman editor and author of St. Louis, who died Dec. 26 at the age of seventy-three years. Mrs. Bennett was at one time connected with the St. Louis *Republic*, and afterward became editor and proprietor of the Hannibal (Mo.) *Courier*. Since 1884 Mrs. Bennett had occupied herself with the preparation of magazine articles, and, still in intellectual vigor despite her advanced age, she had only a month prior to her death completed a motion-picture scenario for one of the large film syndicates.

Frank H. Golding, who for the last two years has been general manager of the Atlantic City Electric Company, Atlantic City, N. J., has just been appointed general manager of the Canton (Ohio) Electric Company, succeeding W. C. Anderson, the vice-president and general manager of the company, who, as noted in these columns, died on Dec. 23. Before going to Atlantic City Mr. Golding was general manager of the Rockford (Ill.) Electric Company, and prior thereto he was contract agent for the Dayton (Ohio) Power & Light Company.

F. H. GOLDING

Obituary

Thomas J. Agnew, vice-president and operating head of the United Gas & Electric Improvement Company of Merida, Yucatan, Mexico, died at New York, Dec. 22. Mr. Agnew had lived in Merida for the last sixteen years.

H. P. Kernochan, for several years manager of the Syracuse (N. Y.) office of the General Electric Company, and more recently a member of the company's New York City staff engaged in special sales and promotion work, died of pneumonia Jan. 3.

T. L. Willson, who took a prominent part in the early development of the calcium-carbide industry, is dead at New York City. Mr. Willson began his scientific work in 1880, when he constructed an arc outfit used for street lighting at Hamilton, Ontario, Canada. Another achievement was the acetylene gas buoy which bears his name. Until two years ago Mr. Willson was president of the International Marine Signal Company. Since that time he had devoted his entire attention to a new process for producing nitrogenous fertilizers from the air.

Thomas Wallace, managing director of the W. A. Clark Wire Company of New York and a pioneer in the manufacture of copper wire, died on Jan. 1 at the age of eighty-nine. He was born in Manchester, England, and came to this country when he was five years old. In 1839 his father established the first wire mill in this country at Annsville, N. Y., and in 1841 the elder Wallace moved his business to Derby, Conn. In 1849 the firm of Wallace & Sons was established at Ansonia, Conn., and was the first concern to make copper wire in this country. Mr. Wallace was the first manufacturer to introduce continuous fine-wire machinery for drawing fine brass and copper wire, a process which revolutionized the industry. For the last fifteen years he was managing director of the W. A. Clark Wire Company.

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Electric Transmission Increases Flexibility of Gasoline-Operated Automobiles

Although the principle of the Entz electric-transmission system for automobiles has not been changed since the system was first described in the ELECTRICAL WORLD of Jan. 31, 1914, many improvements in the electric apparatus utilized on cars provided with the Entz transmission as manufactured by R. M. Owen & Company, Fifty-seventh Street and Broadway, New York, are worthy of mention.

With this electric transmission system, it will be noted, the engine flywheel, clutch pedal, gears, starting and lighting apparatus, etc., are eliminated. The transmission unit consists of a generator, the field of which is bolted to the engine crank shaft, and a motor whose armature is attached to the same shaft to which the armature of the generator is fastened and whose field is stationary. There is no mechanical connection between the rear axle and the gasoline engine, but the torque of the engine is transmitted to the driving axle electrically and the car is operated through what is in effect a slipping clutch. Instead, however, of wasting in resistance the energy generated by the slip the power is utilized at intermediate speeds to drive the motor. In Fig. 1 is shown a diagrammatic section of the transmission system. The two armatures are identical and both are fastened to a hollow shaft which is attached to the propeller shaft. Change in speed is accomplished by gradually decreasing the motor-field excitation and finally short-circuiting the generator brushes at high speed.

The car is operated by a six-cylinder Buda engine, which is started by the generator operating as a motor and taking energy from the battery. Attached to the steering wheel is a controller lever, as shown in Fig. 2. When this lever is turned to the charging position, energy is taken from the generator to charge the battery. On the first car motion the field windings of the generator are connected through resistance, the control lever being placed in the first position, marked (1) in Fig. 2. In the second position the generator field is short-circuited. In the third position resistance is switched into the field coils of the motor, thereby throwing a greater load on the generator, which is equivalent to tightening the magnetic grip on the armature. In the fourth position more resistance is put into the motor field. In successive positions resistance is added until the seventh

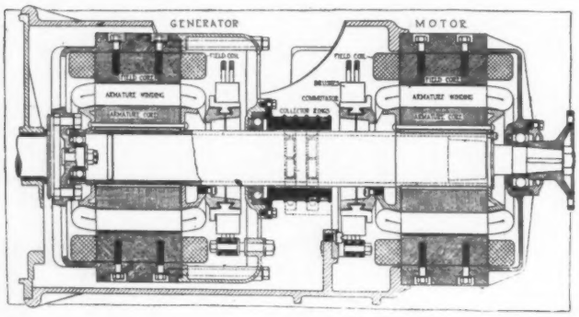


FIG. 1—DIAGRAMMATIC SECTION OF TRANSMISSION SYSTEM

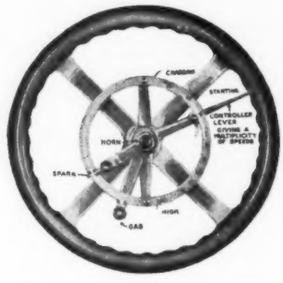
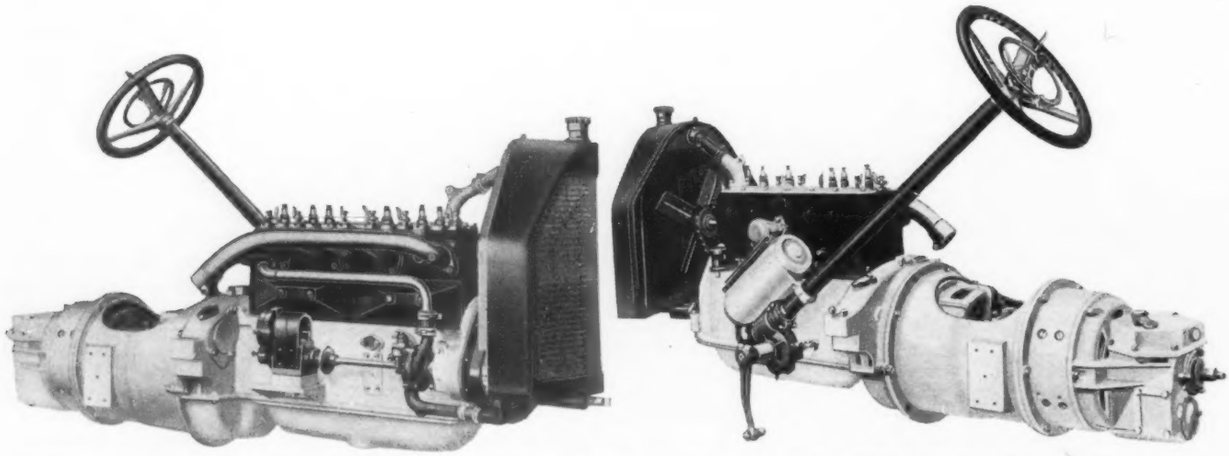


FIG. 2—STEERING WHEEL AND CONTROLLER LEVER



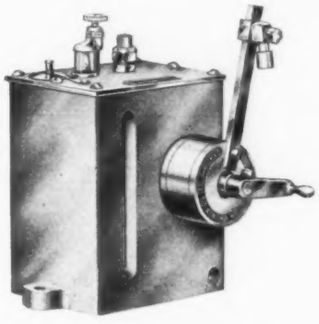
FIGS. 3 AND 4—COMPLETE TRANSMISSION OUTFIT, SHOWING ENGINE AND MOTOR AND GENERATOR INCLOSED IN CASE

or high-speed position, when all the energy generated is utilized to drive the armature. When the car is running the electric transmission acts as a brake if the lever is turned to the neutral position.

In Fig. 4 is shown the controller box at the base of the steering column, containing all switches and resistance coils. The cars operating by electric transmission are being made in the familiar touring, limousine and roadster types. The weight of the seven-passenger car complete is 4250 lb.

Rectangular Lubricator

A lubricator which is built in sizes of from one to seventy-two feeds and is designed for use with any type of reciprocating power-plant unit, steam pump, dredge, steam shovel, etc., has been developed by the Richardson-Phenix Company, Milwaukee, Wis. The device shown herewith is a one-speed lubricator and known as model T. The shaft runs the entire length of the lubricator and is given a positive rotary motion by means of an external lever arm and ratchet wheel. Eccentrics on the shaft cause a double pumping unit for each feed to oscillate vertically. The lower pump measures out a definite quantity of oil and forces it up to the sight-feed glass, where the rate of flow of the oil is readily visible. The top or forcing plunger takes its suction from the bottom of the sight-feed chamber and forces the oil out into the discharge line. The amount of oil fed for each stroke of the pumping plungers depends upon the vertical location of the sleeve around the lower or measuring plunger. This sleeve is



SINGLE-FEED LUBRICATOR WITH MEANS FOR REGULATING RATE OF FLOW OF OIL

moved up or down by means of the adjusting thumb nut at the top of the lubricator. When the sleeve is at the highest position the entire amount of oil drawn in by the upward stroke of the lower plunger is forced out through the sight feed, whereas when the sleeve is at its lower position the plunger does not go entirely to the end of the cylinder and therefore only a small amount of oil is forced out. Any rate of feed from a drop or two a minute to a steady stream can be secured. The lubricator tank is filled through a covered opening in the top, the oil passing through a strainer. A cored opening threaded at each end runs the entire length of the lubricator tank, so that if the oil is very heavy or the lubricator is in a cold place a steam line can be connected up to keep the oil warm. A drain plug near the bottom of the tank permits of emptying the lubricator without removing it from its setting.

Heavy-Construction Hot-Bonnet Oil Engine

The Bessemer Gas Engine Company, Grove City, Pa., has developed a line of type IV oil engines, as they are called, of the single-cylinder and twin-cylinder two-stroke-cycle types with

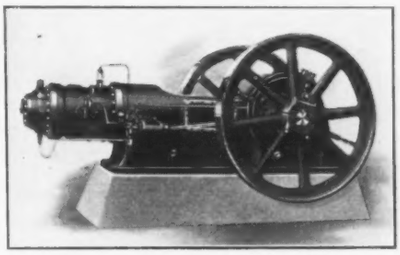


FIG. 1—SINGLE-CYLINDER TWO-STROKE-CYCLE OIL ENGINE

ratings up to 85 hp. for the former type and up to 180 hp. for the latter type. The crank end of the cylinder is used as an air pump, furnishing the air necessary for combustion of the oil. Into this crank end of the cylinder during the head-end stroke of the piston air is drawn through the valve at the bottom, filling the evacuated space at atmospheric pressure. During the crank-end stroke of the piston the air is compressed slightly (to about 5 lb. per square inch), and immediately upon the uncovering of the inlet port in the upper side of the cylinder by the piston the compressed air rushes to the head end of the cylinder, sweeping before it and out of the exhaust ports at the bottom of the cylinder the burned products of the previous charge. Upon the following head-end stroke the fresh charge is compressed in the combustion end of the cylinder while a new charge is being drawn in at the crank end of the cylinder. Near the dead center a pump injects fuel into the combustion chamber, which is ignited by contact with the hot surface of the ignition bonnet in the head and, upon burning, pro-

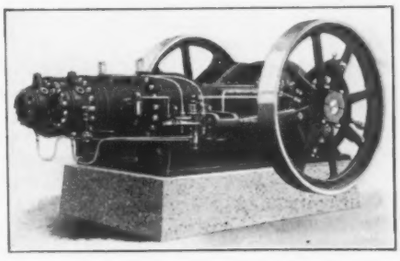


FIG. 2—TWIN-CYLINDER OIL ENGINE

duces a rise in pressure that drives the piston outward upon its power stroke. The ignition bonnet is heated by means of a gas or kerosene torch for a few minutes before starting, after which the combustion supplies the necessary heat for ignition.

The fuel is injected in a finely atomized state from the bottom of the combustion chamber in an upward direction in order not only that the fuel may seek its oxygen for combustion in passing through the air charge as a result of injection but also that the unconsumed portions of the fuel, carbon, etc., shall have no other course than to shower downward again through the rapidly agitated and burning gases below and be consumed. The fuel consequently has no opportunity to cake and carbonize on the red-hot metal. The engines are started by a 4-in. by 4-in. vertical single-acting air compressor with water-jacketed cylinder, which is equipped with an air tank.

The bedplate and cylinder of the engines are of heavy construction. Use is made of steel cross-heads with phosphor-bronze shoes and a governor of the inertia type.

Waterproof Dry Battery

To overcome the usual objections to dry batteries on account of atmospheric and temperature changes, a dry battery of waterproof construction has been de-

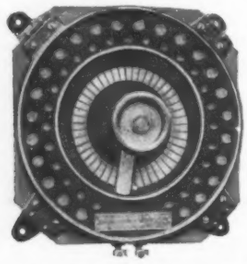
FIGS. 1 AND 2—SECTIONAL DRAWING AND OUTSIDE VIEW OF IGNITION DRY BATTERY

veloped, in which the active part of the battery—that is, the zinc electrode—has been insulated in such a manner as to minimize the retarding effect upon the electrolyte due to low temperatures and to restrain the violent chemical action caused by extremely high temperatures. It is generally known that dry batteries decrease in efficiency through age. This is caused by the transference of energy between the negative and positive poles as a result chiefly of moisture in the atmosphere affecting the zinc container. As shown in the sectional view in Fig. 1, the zinc cup of the weatherproof battery is formed with an outwardly flaring upper edge. This flaring edge engages the upper edge of the outside container, and as the inner member is spaced cen-

trally within the outer container, a surrounding dead-air space is provided for. The cell itself is coated with a special adhesive varnish which is impervious to moisture, thus forming an insulating coating. A jacket formed of a sheet of asbestos or some similar heat-insulating material is placed around the zinc container while the varnish coat is still sticky, thus providing a protecting covering which is a poor conductor of heat; consequently the cell retains a comparatively uniform temperature, since outside changes of temperature affect it but slowly. When the cell is placed within the external cover the top is sealed so that the sealing wax extends over the top of the flanged zinc container, effectively closing the air space surrounding the cell and thereby forming an insulating jacket which is effective against changes in temperature. The seal extending beyond the top edge of the inner container secures the outer carton to the cell and forms a unit from which the outer carton cannot be removed and replaced in a fraudulent manner. To secure the bottom cap of the outer carton and to make this carton waterproof, the ordinary fiber-bottom cap has been replaced by a black-japanned metal bottom which on the inside is insulated from the zinc cup by a specially formed, paraffined paper cup. The batteries are being manufactured in the standard No. 6, No. 7 and No. 8 sizes and are being made especially for ignition and telephone service. Waterproof batteries are also being developed for flashlamps. The "master" batteries, as they are called, are being made by the United Battery Corporation, 160 John Street, Brooklyn, N. Y.

Square-Type Field Rheostats

The circular-plate type of field rheostat made in several sizes by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has recently been superseded by a new line of 6-in., 9-in., 12-in. and 15-in. square-plate rheostats, which are said to be more economical of space. They may be used singly or mounted in tandem and are provided with a common operating shaft. Each plate is a complete rheostat with radial



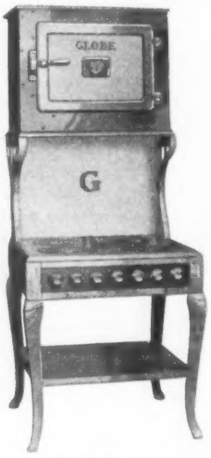
FIELD RHEOSTAT WITH SQUARE PLATE

lever, contacts and resistor. The resistance wire is reflexed to provide for expansion and to cover the surface adequately. It is fastened to the soapstone base and covered with a special fireproof cement. The rheostats are of the "convertible" type provided with a substantial insulated knob on the front and with a clutch member at the rear and may therefore be mounted either on the front or back of the switchboard. If the rheostat is to be mounted on the back of the switchboard, a separate hand wheel and dial plate are, of course, employed.

Electric Range with Overhead Oven

Three models of electric ranges have been added to the line of the Globe Stove & Range Company of Kokomo, Ind. In one of these, a picture of which is shown herewith, the oven has been elevated to a position above the cooking surface. The advantages of this type of range, as pointed out by the manufacturer, are that greater convenience is afforded the range operator and less floor space is occupied by the range.

On the cooking surface of the stove the two 8-in. heating elements in front are arranged for operating at three temperatures when using 1100 watts, 880 watts and 370 watts respectively. The two 6-in. elements in the rear are rated at 880 watts and operate at only one temperature. In the center of the stove is a 500-watt totally inclosed simmering unit. The oven measures



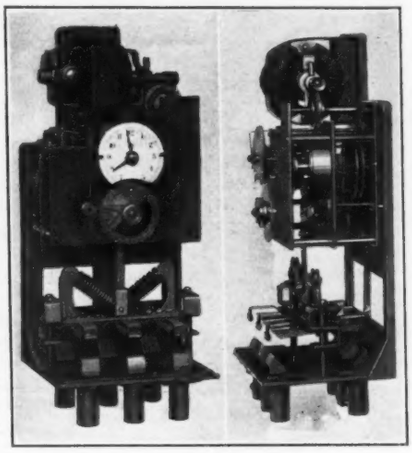
ELECTRIC RANGE WITH OVERHEAD OVEN, FOUR HEATING UNITS AND ONE SIMMERING UNIT

13.25 in. by 13.5 in. by 19.25 in. inside and is heated by two 1000-watt elements placed one at the top and one at the bottom. The range complete can be placed in a 2.5-ft. by 2.5-ft. floor space.

Improvements in Motor-Wound Time Switches

Changes which have been made in the design of the motor-wound time switch produced by the Minerallac Electric Company of 1043 West Washington Boulevard, Chicago, have reduced the number of necessary parts, making the switch simpler and at the same time more reliable. The switch is built on the unit-part plan and consists of an escapement, a spring and winding differential, a motor, a cast-iron frame and a case. Each unit is easily accessible.

Where two springs were used in the former model only one is used in the new type. This performs a double duty. Power is taken from one end of this spring for driving the clock train and from the other end for operating



FIGS. 1 AND 2—FRONT AND SIDE VIEWS OF AIR-BREAK TIME SWITCH

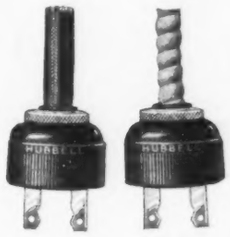
the switch. Power which is supplied from the motor for winding is applied at the center of the spring, and the whole mechanism is so arranged that either of the two operations performed by power from the spring ends may be successfully accomplished while the motor is winding the spring from the middle. The motor will also rewind the spring regardless of whether the switching mechanism or the clock train runs it down. Regardless of how long the line on which the switch is placed is without energy, the motor will immediately and completely rewind the spring upon restoration of energy to the line. The spring itself has sufficient power to open and close the switch many times should the rewinding current fail.

In the design of the clock, as well as in the design of all operating parts, it was the manufacturer's aim to attain freedom of action without allowing back-lash, so that sudden temperature changes could not cause the switch to stick. It is claimed that the switch will not fail to operate even under severest weather conditions because if the switch should be temporarily stopped by cold the motor windings would soon produce enough heat to release the cold parts.

The switch gear proper with which this unit may be equipped is of several types. The one shown herewith is of the three-pole, air-break, wiping-contact type with arcing tips. By replacing the eccentric driving this type of switch with a set of beveled gears a rotary snap switch may be inserted and operated. For circuits of higher potentials an oil switch, similar in type to the air-break switch shown, may be used. It can be used on circuits carrying 4 amp. and operating at 4400 volts. When the oil switch is employed, however, it is incased in a tank suspended beneath the time-switch frame. For all of these combinations the connection terminals are placed just below the bed-plate. The covers of the terminal case and the time switch have been arranged so that one lock closes and holds both parts locked.

Improved Strain-Relief Cap

The strain-relief cap which was described in the ELECTRICAL WORLD of Sept. 25, 1915, page 712, has been strengthened and improved, making it, according to the manufacturer, Harvey Hubbell, Inc., Bridgeport, Conn., practically indestructible. In the accompanying illustration the cap is shown

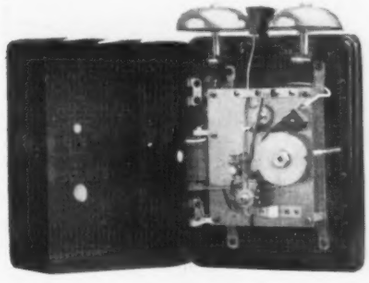


FIGS. 1 AND 2—PLUG CAP WITH REINFORCED CORD AND ARMORED CABLE

in service with an armored cable and a reinforced cord. The cap is particularly adapted for use in the industrial field, where both armored and reinforced cord are employed.

Automatic Door-Releasing or Opening Device

A spring-operated device designed to release the lock of a door of an apartment-house entrance when an apartment bell is operated from a button in the vestibule is shown in the illustration herewith. This automatic door-opening or releasing device is connected by three wires to the bell and button found in the kitchen or hall of the apartment and utilized to operate the vestibule door lock. A caller wishing to enter presses the button in the vestibule, causing the bell to ring and the opener to operate the vestibule door lock by a series of clicks, the clicks being continued long enough for the caller to pass through and enter the apartment-house hall. The period between the ringing and the opening can be adjusted, since the distances between the

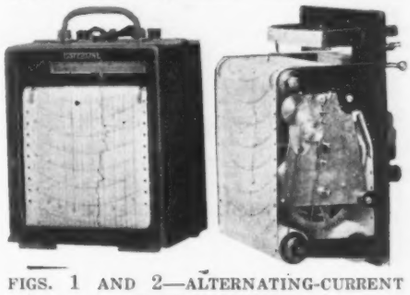


MECHANISM OF SPRING-WOUND DEVICE FOR OPENING APARTMENT-HOUSE ENTRANCE DOORS

button in the vestibule and the door vary. After the bell has rung and the device has opened the door, the opener causes one stroke to be sounded on the bell, thus informing the resident that it has released the lock. After about 350 operations the opener automatically stops the door-opening mechanism but does not interfere with the ringing from the vestibule. If a single stroke is not sounded on the bell after it has been rung from the entry, the spring is unwound and the opener does not operate the vestibule-door lock. On rewinding the device it will be able to operate another 350 times. The device can be switched off by a mechanical switch so as to stop it from opening the door after the bell has been rung without interfering with the ringing from the vestibule. It can also be switched off to prevent ringing. The automatic releasing device is valuable for deceiving thieves who ring the bell of an apartment to see whether the residents are home or not; naturally, if the person in the vestibule hears a clicking sound, he assumes that the residents are in. The device has been developed by Charles E. Lindig, 5 Woodcrest Avenue, White Plains, N. Y.

Graphic Voltmeters and Ammeters

A new line of graphic meters designed for checking up voltage and current on alternating-current circuits has just been brought out by the Esterline Company, Indianapolis, Ind. The instruments are being made in both the switchboard and portable

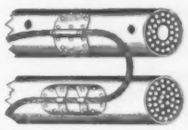


FIGS. 1 AND 2—ALTERNATING-CURRENT GRAPHIC METER

types and weigh only 9.5 lb. Although light in weight, they are designed for heavy service. The case is of cast aluminum, the front half being removable. The portable type of instrument is provided with a brass handle, while the switchboard type is fitted with mounting studs. The chart is 26 ft. in length and is driven at a speed of either 0.75 in. per hour or 1.5 in. per hour by an eight-day jeweled lever clock. A re-roll is also provided for the used chart. A clear, open scale is obtained, the manufacturer claims, the scale being 4.5 in. in width and printed on perforated paper 6 in. wide. An indicating scale is also utilized, enabling readings to be taken without opening the front. The movement is of the moving iron-vane type, the armature being mounted in jewel bearings. The clock movement, scale plate and all parts are mounted on a center casting, thus insuring true alignment and making all parts interchangeable and easily accessible for inspection or replacement. The ink is contained in a large stationary ink-well, and the manufacturer points out that a continuous record can be obtained with a metal pen with minimum friction.

Copper Bond Plates

A bond plate made by T. J. Cope, 3244 North Fifteenth Street, Philadelphia, Pa., and designed to take care of stray currents on underground and other types of lead-sheathed cables, is shown herewith attached to a bond wire. The plates are of copper, perforated and coated with solder. The wire is placed

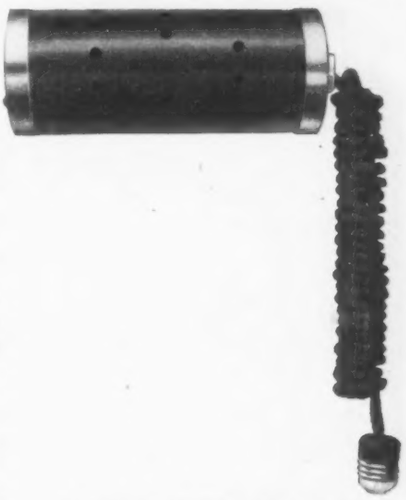


BOND PLATES ATTACHED TO CABLES

in position in the plate and the plate is soldered to the cable. The wire used for bonding can be grounded when desired or attached to a return feeder, thus carrying off stray currents and reducing electrolysis. The bond plate is being made in two sizes—2 in. by 1.25 in. and 2.875 in. by 1.75 in.

Electric Automobile Radiator Heater

The increasing use of automobiles during the winter season has brought into prominence the problem of the cold garage. To allow a car to stand in an unheated garage for any length of time presages a frozen radiator and a hopelessly cold engine. To avoid the former evil the radiator can be drained, although this means a great amount of work and trouble; the latter evil is unavoidable no matter how many rugs are piled on the radiator. The Western Electric Company, 463 West Street, New York, has put on the market an electric heater 7.5 in. long and provided with 10 ft. of cord, the plug of which can be attached to any lamp socket,



AUTOMOBILE RADIATOR HEATER

which may be placed inside the hood of the automobile, thereby obviating cold engines and frozen radiators. The cost of the heater is small and its energy consumption low, the makers point out, giving the motorist complete protection against one of the worst obstacles to winter motoring.

Electric Vacuum Cleaner with Inclosed Dust Bag

A small, compact electrically operated vacuum cleaner with its dust bag entirely inclosed in a cylinder between the intake or nozzle and the motor and fan has just been developed by the Regina Company, 47 West Thirty-fourth Street, New York. The model MC machine, as it is called, is operated by a General Electric Company motor and is designed to produce a very large air displacement. The intake is 12 in. wide, and directly behind it is a revolving brush for picking up threads and lint. The dust bag may be easily removed for emptying, and extra attachments are provided for cleaning draperies, upholstery, mattresses, walls, etc. The machine may also be utilized as a blower by attaching a hose to the exhaust opening. Lubrication of the motor is accomplished by self-feeding oil cups on top of the motor case, which re-

PORTABLE VACUUM CLEANER WITH 12-IN. INTAKE

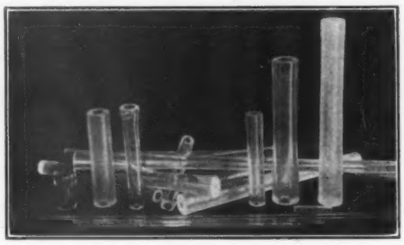
quire only occasional refilling. The machine measures 19.5 in. long, 12 in. wide and 7.75 in. high, not including the handle. The attachments for the machine include 8 ft. of reinforced cloth-covered rubber hose, a suction attachment for connecting the hose to the cleaner, a blower connection for connecting the hose to the exhaust opening of the cleaner, a tool for connecting the hose to the extension tube, a nickel-plated extension tube, a tool for cleaning draperies, curtains, upholstery, etc., a brush for cleaning walls, moldings, books, clothes, etc., and a nozzle to be attached to hose for blowing purposes and for drying hair, etc., also for cleaning radiators, mattresses, inside of pianos, etc.

Cable Pot-Heads

In an article entitled "Cable Pot-Heads for Disconnecting and Non-Disconnecting Service," which appeared in the ELECTRICAL WORLD of Dec. 25, 1915, it was erroneously stated that the pot-heads were developed by the Philadelphia Electric Company. The name of the manufacturer should have been the Philadelphia Electric Company Supply Department, 132 South Eleventh Street, Philadelphia, Pa.

Insulating Tubing

In the accompanying illustration are shown several types of tubing made of an insulating material called "boro-porcelain." The tubes vary in length

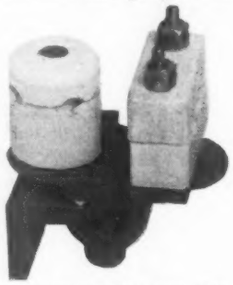


INSULATING TUBING FOR HIGH-VOLTAGE CIRCUITS

from 3 in. to 7 ft. and are designed for use on high-voltage circuits. The material, the manufacturer claims, has a low electrostatic capacity and high and uniform dielectric strength. Boro-porcelain is also utilized for insulators, as already mentioned in the ELECTRICAL WORLD of May 29, 1915, page 1429, and April 3, 1915, page 869. The material is being placed on the market by Fred M. Locke, Victor, N. Y.

Insulator Supports

Several types of supports for insulators and conduits which can be attached to the steel framework of buildings without drilling holes, and which are especially well adapted for electric wiring in mills, foundries, shops, train sheds, etc., are being made by the C. C. Korns Company, Johnstown, Pa. The supports consist of malleable-iron brackets or clamps with a piece of tempered tool steel inserted in one of the clamping members. The opposing clamping member has its bearing spaced in relation to the tempered biting element and the projection at the

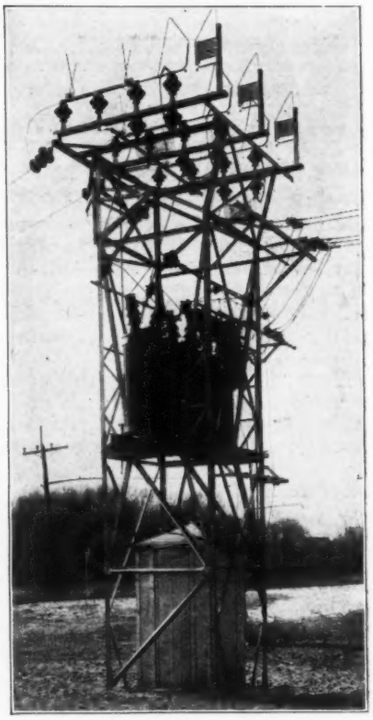


SUPPORT WITH INSULATOR ATTACHED

end of the clamp. On screwing up the nut on the clamp bolt of the insulator support, the tempered steel biting element is forced into the structural member to which it is being attached. Similarly, in the case of the conduit support, on screwing up the nut on the bolt, the pipe or conduit is securely held between the concaved ends of clamping members, while at the same time the tempered steel biting element at the opposite end of the clamp is forced into the structural member. The insulator support is being made in four sizes—1 in., 1.5 in., 2 in. and 2.5 in.—which are designed to accommodate No. 1 to No. 4 inclusive B. & D. cleats. The pipe or conduit supports are being made in standard pipe sizes from 0.5 in. to 3.5 in. inclusive.

Steel-Tower Outdoor Substations

Progress in high-tension distribution made during the past four years has demonstrated the fact that it is no longer a question of whether outdoor substations should be used, but rather of how many can be advantageously installed in a given territory. The out-



33,000-VOLT, 150-KW., THREE-PHASE STEEL-TOWER OUTDOOR SUBSTATION

door substation now occupies a very definite place in high-tension service, and there is a tendency to employ the steel-tower type. The substation illustrated herewith occupies a ground space of 6 ft. by 6 ft. and is designed for a maximum capacity of 150-kw. at 33,000 volts. The three-pole switch is controlled by a locking-type handle which can be either near the ground or approximately 12 ft. above, as in the installation shown. A feature of the outfit is the steel housing, which is 4 ft. by 4 ft. by 7 ft., at the base of the tower. In this house are the various metering equipments, distribution panels, feeder regulators, etc. The equipment was made by the Delta-Star Electric Company, Chicago.

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

New York Automobile Show

The annual New York Automobile Show was opened to the public on Dec. 31 at the Grand Central Palace, where were exhibited automobiles of both gasoline and electric drive. The gasoline motors showed a tendency to a higher speed and higher efficiency.

In the 1916 models the single-ignition and two-unit lighting and starting equipments stand out prominently in the electrical systems. The electrical generators are mostly simpler and neater, and a tendency is shown toward standardization of the connection to the motor. Of the 1916 models 98.8 per cent have electric lighting and starting.

It was in 1912 that electric lighting and starting became a part of the equipment of automobiles, and in that year 2 per cent of all of the cars manufactured were so equipped. The 1912 system was merely tacked on the car, while the present demands are for a simple, compact, workmanlike system that is not an accessory but an integral part of the machine.

Generator installation has greatly increased the use of the battery-ignition system, and it is now used on 62 per cent of all makes. All of the eight-cylinder cars have battery ignition, as have three of the twelve-cylinder makes.

The cantilever spring is now an established type, and but few platform springs were noticed. The frames of the new cars are stronger. The bodies of the 1916 cars differ largely from those of 1915. There are fewer makes of car and fewer designs of chassis, but because of the many new types of cars the choice is wider than ever before.

New Enterprise to Establish Market for American Goods in the Orient

With offices already established in England, France, Russia, Spain, Portugal, Italy, Cuba and South Africa, Gaston, Williams & Wigmore, Inc., of New York City, are now starting a campaign for the development of a broader market for goods of American manufacture throughout the Orient. Joseph J. Keegan and Hilliard J. Rosencrantz, who have been associated with American trade development in the Far East for the last sixteen years, are leaving for China in January as managing directors of the Far Eastern division of the company, and will establish an office and showrooms in Shanghai as early as possible in the new year. The business of the company will be divided into departments to include electric-railway materials, plant and accessories.

A selling force will be organized, formed of experienced Americans and technically educated Chinese already familiar with the trade. Later branches will be opened in other centers throughout China and also in Japan and the Dutch East Indies. The branch in Japan will be in charge of J. B. J. Gibbs, who has been engaged in similar commercial work in that country for the last ten years.

The organization, which does a general import and export business, will sell at the manufacturers' prices to the Eastern customer, paying cash in New York and extending credit on the other end through its own facilities. The company is endeavoring to establish connections with American manufacturers, making units to form complete electrical installation and maintenance necessities, and where it is possible and the line is of sufficient magnitude to have the co-operation of the manufacturers' own technical men, who will be directed from the local offices and whose sales will be guaranteed by the company.

A large part of the concern's business will be to finance the Chinese undertakings in electrical and constructive lines, and it was stated that the company through its financial connections would be able to extend credit wherever necessary even up to two years. The company, which has been doing a large business in the Russian trade until lately, had a nominal capitalization of $1,000, which has since been increased to $1,000,000 paid up.

Parade Marks Entrance of Electric Vehicle Into Wholesale Grocery Field

Eighty-nine electric trucks loaded with twenty carloads of coffee and tea paraded through Chicago's "Loop" district on the morning of Dec. 22. The procession marked the inauguration of exclusive electric-truck delivery service by Reid, Murdock & Company, wholesale grocers. Twenty-four mounted policemen and sixty pieces from the Commonwealth Edison Company's band preceded the parade and helped attract the attention of thousands of Christmas shoppers in the crowded streets.

The groceries in the parade were consigned to 1920 of the company's customers in 875 cities in the United States. Each of these retail merchants had previously been told of the electric feature of the parade. Consequently as an advertising campaign for the electric vehicle the parade was of national interest in the grocery trade.

HOW A CHICAGO GROCERY FIRM ANNOUNCED ITS EXCLUSIVE ELECTRIC DELIVERY SERVICE

The initial purchase of trucks by the grocery concern included eleven Walker vehicles of the 3-ton and 5-ton sizes. These vehicles are the nucleus of a large fleet which the company will buy, and it is rumored that some additional electric vehicles will be bought in 1916. For the time being Reid, Murdock & Company will garage its own electric fleet.

Public Service Commission News

Vermont Commission

The Vermont Public Service Commission has issued an order which virtually upholds the Vermont Power & Manufacturing Company's method of charging for energy on the basis of the number of outlets in a house. The company, which has its headquarters at St. Albans, is required within thirty days to modify its general rates so as to include therein the sale of electricity for the operation of domestic housekeeping appliances, but excluding industrial motor service, charging storage batteries, electric furnace and electrolytic service, and the operation of generators for electric-lighting purposes. It is also ordered to submit for approval a block form of quantity discounts on its commercial, general and general limited rates in place of the step form of quantity discounts now in force, the new system to be so framed as not to decrease existing discounts.

Rhode Island Commission

The Rhode Island Public Utilities Commission has handed down a decision on the petition of citizens of Portsmouth asking that the Bay State Street Railway Company, which supplies electricity in that town, be required to extend its service to Bristol Ferry. The commission orders that extensions shall be made where consumers will guarantee a return of $560.79 for a period of six years. This amount was arrived at after going into detailed figures of construction costs.

Wisconsin Commission

The application of the Frederic Rural Telephone Company for authority to establish an exchange at Frederic was not allowed by the Railroad Commission of Wisconsin. It appears that the Tri-State Telephone & Telegraph Company furnishes either direct or switching service for practically the entire community, and that the alleged poor service furnished by this company was given as the reason for the desired competitive exchange. In denying the application the commission noted that the lines for which switching service is furnished by the Tri-State company are heavily overloaded and kept in poor repair, and that, therefore, all of the defects of service are not chargeable to the Tri-State company. The evidence showed, moreover, that this company is attempting to furnish as good service as the facilities of the connecting lines will permit. A consolidation of all lines in the district was suggested by the commission.

California Commission

An order dismissing the various complaints of the Pacific Telephone & Telegraph Company against the Coast Counties Gas & Electric Company, the Great Western Power Company and the Sierra & San Francisco Power Company in induction interference cases has finally been granted by the Railroad Commission of California. These complaints, which were filed in 1912 and alleged that the proximity of power lines to telephone lines made telephone communication impossible and created a hazard of fire and electrical shock, were the direct cause of the appointment of the general committee on inductive interference. Based upon the report of the committee, which indicates that the principal remedy for interference is in the transposition of wires, the commission now requires electric companies to make every reasonable effort to avoid lines paralleling those of telephone companies, but holds that where such lines are necessary they should be arranged so as to minimize the dangers of inductive interference.

The California Railroad Commission has rendered a decision authorizing the Great Western Power Company of California to issue $27,498,600 par value of common capital stock, $5,263,200 par value of 7 per cent preferred stock, and $5,000,000 face value of ten-year 6 per cent convertible gold debentures. These securities will be used to acquire the stock of Great Western Power Company and to provide funds for extensions and improvements.

The commission states that it has been unable to ascertain to what extent, if at all, the capital stock of the Great Western Power Company at the time of its issue represented tangible value, nor does the evidence show what consideration the Great Western Power Company received when it issued $2,500,000 par value of its capital stock as part payment for the stock of the City Electric Company. The stock of the Great Western Power Company was issued prior to the enactment of the public utilities act, and is the only property which the Western Power Company, a subsidiary of the Great Western, owns. Against this stock the Western Power Company has issued its $20,670,000 par value of capital stock, which is held by the general public.

The authority granted to issue stock is given upon the express condition that each certificate of the common capital stock issued by the Great Western Power Company of California shall contain this language:

"This certificate of stock has been issued pursuant to Decision No. 2985, rendered on Dec. 20, 1915, by the Railroad Commission of the State of California, in Application No. 1999. In said decision the Railroad Commission states that the issue of this stock is authorized only because of the practical necessity of exchanging the same for a like amount of stock of Great Western Power Company, issued before the law of California required the Railroad Commission's consent to the issue of capital stock by public utilities. The Railroad Commission of the State of California in its decision states that it has been unable to ascertain to what extent, if at all, the capital stock of Great Western Power Company at the time of its issue represented tangible value."

The commission further says:

"It should be distinctly understood that the Railroad Commission's action in authorizing the issue of the common capital stock as herein requested must not be taken as a precedent. The authorization is being made solely because the capital stock of the Great Western Power Company was issued prior to the effective date of the public utilities act and is now outstanding, and because applicant herein earnestly insists that the exchange of an equivalent amount of its common capital stock for the stock of the Great Western Power Company now held by the New Jersey corporation is a condition precedent to the success of further satisfactory financing by the Great Western Power system."

In a statement submitted to the commission with its application, the Great Western Power Company of California proposed to use $3,000,000, the capital stock of the City Electric Company; to cause $1,500,000 to be expended for a transmission line from Big Bend to Oakland, and $250,000 for two cables to be laid under the waters of San Francisco Bay. In regard to these proposed expenditures the commission says:

"This commission is not informed as to the value of the capital stock of the City Electric Company, for which stock, under this amended statement, the Great Western Power Company of California is to pay $3,000,000. We are not informed whether the transmission line from Big Bend to Oakland and the third and fourth bay cables are to be installed by and become the property of the Great Western Power Company of California, or whether it is intended that these properties shall be constructed by and remain the property of some one or more of the other corporations of the Great Western Power system."

In regard to the approval of the general financial plan of the Great Western Power Company of California, the commission says:

"The Railroad Commission approves of the general plan of consolidating the properties of the Great Western Power system and of thereafter executing a general mortgage and issuing bonds thereunder for proper purposes and in proper amounts as may hereafter be authorized by the Railroad Commission, but cannot commit itself, in advance of the presentation of the usual formal application or applications, to the details of such general plan."

In order that it may act intelligently upon these applications when they are filed, the commission suggests that a valuation be made of the constituent companies of the Great Western Power system.

The Railroad Commission has dismissed the San Joaquin Light & Power Corporation's application for authority to renew six promissory notes totaling $86,722.44, the company stating that it has sufficient funds to pay notes at maturity.

Colorado Commission

The Public Utilities Commission of the State of Colorado has handed down an order in the case of the Colorado Springs Light, Heat & Power Company, holding that its rates for electrical energy are excessive and unreasonable. After considering all of the testimony and evidence in the case bearing upon the value of the plant and the cost to reproduce, the original costs, the investment, the present value, including preliminary and development costs, engineering and supervision, interest, insurance, organization and legal expense during construction, contingencies, working capital and all other elements of value (tangible and intangible), and taking into consideration that the plant is in successful operation and a "going concern," the commission finds the fair value of the electric and hydro property of the Colorado Springs Light, Heat & Power Company for the purposes of determining reasonable and just rates to be $1,481,762.

It also found that the Colorado Springs Light, Heat & Power Company was earning 12.27 per cent per annum on the fair and reasonable value of its electric and hydro property, and under its instructions the electrical engineer of the commission prepared a schedule of rates and charges, the revenues of which will yield a return in excess of 7½ per cent per annum upon the present value of the property of the corporation as found by the commission. It is ordered that the new schedule of rates and charges shall become effective Jan. 1, 1916, and shall apply to all service furnished after that date.

The commission finds the fair value of the gas property of the company for the purposes of determining reasonable and just rates to be $710,917, and that the company is earning 1.16 per cent per annum on the fair and reasonable value of its gas property. The commission expressed its willingness to entertain a complaint from the corporation in the form of a request for an increase in its rates and charges covering the sale of gas, accompanied by evidence sufficient to justify the commission in ordering an increase in such rates and charges.

The present fair value of the steam property of the corporation in use and useful in the sale of steam heat, according to the commission, is $122,774. It was also found that there is an annual deficit, which includes $8,000 annual depreciation reserve in the sum of $13,912 The laws of Colorado pertaining to public utilities and the regulation thereof by the Public Utilities Commission of the State of Colorado enumerate by name all public utilities which shall be under the jurisdiction of the commission, and the commission has come to the conclusion that it is without jurisdiction in the regulation of the sale of steam.

New York Commissions

The Public Service Commission for the Second District, New York, has approved the transfer of the franchise of John Kimmel to the Silver Creek Electric Company and the exercise by that company of the rights and privileges to construct and maintain an electric plant granted by the franchise. The commission finds that the franchise granted to Kimmel by the village trustees on Feb. 15, 1915, was a valid one; that Kimmel four days later duly accepted the franchise and agreed to carry out its terms, thus making it, under decisions of the United States Supreme Court, a binding contract not susceptible of revocation; that its alleged revocation by a new village board was not valid, and that as about $10,000 has already been invested in the rehabilitation of the Silver Creek plant, which is now prepared to give the community better service than it has ever had, and for twenty-four hours instead of twelve, the public interest of the community demands that the transfer and exercise of the franchise be approved.

The Public Service Commission for the First District has instructed its secretary to communicate immediately with the Attorney-General of the United States, calling his attention to facts brought out in recent gas-rate cases showing what seems to be a discrimination in the price at which gas oil is sold to different gas companies in the city of New York. The commission in addition called for a public hearing, in order to investigate further the prices charged for gas oil. In a recent case involving the rates charged by the Kings County Lighting Company it developed that the company was paying a much higher price for gas oil than other companies in the city. Recently the company notified the commission that the price of gas oil had increased even beyond the figure named in the contract referred to. The company asked the advice of the commission as to the propriety of making another contract at an increased price. When this communication came before the commission the action above stated was taken. It is understood that all oil gas is supplied by the Standard Oil Company or its subsidiaries, and the commission believes that the United States Attorney-General should investigate the various prices charged to different companies in the same locality with the view of determining whether there has been discrimination within the meaning of the federal anti-trust law.

Massachusetts Commission News

The Public Service Commission conducted an investigation of rates for telephone extension service at its offices in Boston on Dec. 30. E. K. Hall, vice-president of the New England Telephone & Telegraph Company, opposed a decrease from the existing usual charge of $6 per instrument per year, submitting figures indicating that the actual yearly cost of maintaining an extension set, including all charges, is over $6.75 per year. He conceded that the service is accelerated by the use of such equipment and that, if the rates are to be altered, they should be raised in flat-rate installations and lowered in measured-service stations. In general the company protested against any piecemeal modification of its rates. Arthur A. Noel, superintendent of the Automatic Telephone Company, New Bedford, Mass., also opposed a reduction, stating that in his system extension service is rendered virtually at a loss and merely to accommodate customers. During the hearing independent manufacturing interests urged the commission to investigate the barring of independently manufactured apparatus from connection with local Bell exchanges.

Knob-and-Tube Work Prohibited in Milwaukee.—After March 1 knob-and-tube wiring will not be permitted in Milwaukee. All electric wires must be placed in conduit or armored cables must be used.

Ground Broken for New 200,000-Hp. Steam Plant.—Ground was broken on Dec. 14 for a 200,000-hp. steam power plant to be built on the river front in the town of Tonawanda, N. Y., for the Buffalo General Electric Company. The plant will cost $1,500,000.

Domestic Output of Quicksilver in 1915.—The domestic output of quicksilver in 1915 was 20,681 flasks of 75 lb. each, valued at $1,768,225. Statistics for 1914 gave a production of 16,548 flasks, valued at $811,680. The production was the largest in value since 1881 and the greatest in quantity since 1912.

Must Furnish Free Service to City.—The City Council of Youngstown, Ohio, enacted an ordinance on Dec. 21 requiring that during the next nine years the Youngstown & Sharon Railway & Light Company must furnish free light service to the city, amounting to $25,000. It is reported that the company has agreed to this demand.

Single Public Service Commission for New York Proposed.—The chairman of the legislative committee investigating the Public Service Commissions of New York proposes to abolish both the city and the upstate commissions and substitute in their places a single commission of seven members, the powers of which would be purely regulatory.

Sleet Conditions.—Engineers of some of the most important Canadian power-transmission lines have decided, from experience, that for ordinary sizes of conductors used the worst conditions may be taken as ¾ in. of sleet adhering to the wire at 32 deg. Fahr. and a wind pressure of 11 lb. per square foot of effective area. Under these conditions it is held that a factor of safety of two is required.

Eugene (Ore.) Takes Over Private Plant.—The City Council of Eugene has ratified the purchase by the city of the franchise and holdings of the Oregon Power Company within the city limits, thereby ending the competition between the municipal plant and the plant and system of the power company. The deal involves $150,000, $50,000 of which is to be paid at once, with deferred payments of $1,250 per month, interest at 5 per cent.

Opportunities in Electrical Work as a Life Occupation.—The opportunities in electrical work as a life occupation were discussed at a meeting of the Society for the Promotion of Vocational Education and Occupational Guidance in Berkeley, Cal., on Dec. 9. The speakers were Dr. Thomas Addison, Pacific Coast manager of the General Electric Company; John A. Britton, general manager of the Pacific Gas & Electric Company; F. W. Alder, teacher of electrical construction in the Vocational High School of Oakland, and E. Rush, past-president of the International Brotherhood of Electrical Workers.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Government Radio Monopoly Sought.—Recommendations that the government control and operate all coastal radio stations within the jurisdiction of the United States and establish a practical monopoly for transmission of all government business are included in the annual report of Captain W. H. G. Bullard, superintendent of the Navy Radio Service.

Permission Granted to Ground on Water Mains in Spokane.—The City Council at Spokane, Wash., has agreed to the request of the Washington Water Power Company for permission to attach ground wires from the secondary alternating-current light and power system to city water mains. Mayor C. M. Fassett presented the result of an investigation into the methods of operation in other cities.

Rat Throws Ohio Town Into Darkness.—One night recently a large rat found its way to the switchboard of the light plant of the Ohio Electric Railway at Lima, Ohio, and ran across the circuit near one of the large oil switches. The flash from this short-circuit threw bits of the carbonized body of the animal over other switches on the board, and within a few seconds every circuit was out of commission. It required half an hour to get the remnants of the animal out of the switches and put the plant in operation again.

Power Company, Fearing Plots, Bars Visitors.—The Niagara Falls (N. Y.) Power Company, whose plant has been one of the show places for visitors to the falls, has issued orders barring all outsiders from the plant. This action was taken, it is explained by officers, to prevent the plant from being destroyed or damaged by plotters. The order was issued soon after the disclosures in New York City concerning the alleged conspiracy to destroy the Welland Canal. It is understood that the Hydraulic Power Company will soon issue a similar order.

Dayton to Have Large New Plant.—One of the largest power plants in Ohio will be constructed by the Dayton Power & Light Company to serve its customers in southwestern Ohio, according to a decision arrived at by the board of directors on Dec. 30. The plant is to be constructed at Miller's Ford, south of Dayton, and will cost about $1,000,000. It is to have a rating about five times that of the two power plants now operated by the company, or 165,000 hp., and will be large enough to take care of all power requirements of Dayton and the other towns now served by the company for some time to come.

Two Towns to Own Lighting Plant in Common.—Bonds have been passed by the twin cities of Graymont and Summit, Ga., for a jointly owned electric plant to be erected midway between the two towns.

Electric Cooking in Twelve Salt Lake City Apartment Houses.—D. C. Green, manager of the Salt Lake City district of the Utah Light & Power Company, reports that twelve new apartment houses recently erected in Salt Lake City have been equipped throughout with electric ranges.

Wireless Communication with Japan Soon.—The Japanese government has notified the Marconi Wireless Telegraph Company of America that the new wireless station at Funabashi, near Tokio, is completed and will be ready for transpacific communication soon after New Year's. The Funabashi plant, which is owned and will be operated by the Japanese government, has a rating of 300 kw. Messages will be relayed to San Francisco, a distance of 5600 miles, through Honolulu. Continental messages to and from the Pacific Coast station will be handled by the Western Union Telegraph Company.

Seattle Municipal Plant to Get Additional Plant.—J. D. Ross, superintendent of lighting of Seattle, Wash., reports that Peter Hebb has announced his willingness to construct a light and power plant on the Hebb site on the White River and turn it over to the city ready for operation as an adjunct to the municipal plant, which is inadequate to serve Seattle's growing needs. The price of the developed project has not yet been set, although Mr. Hebb has several times offered the undeveloped site to the city for $1,000,000. Because the city prefers purchasing a developed site, Mr. Hebb has agreed, tentatively, to construct a plant and turn it over to the city, taking utility bonds to be paid from earnings of the plant in payment.

A Profitable Power-Plant Club.—Taking the initials of the company for its name, a recently organized club of employees at the Webster Street generating station of the Worcester (Mass.) Electric Light Company is making progress along educational lines. For the present a weekly meeting is held at which an informal talk on some topic of engineering or sales importance is given. At one recent meeting a thorough explanation of the construction and operating features of a set of new boilers now being installed in the plant was given to the club by the erecting engineer of the manufacturer, and at another meeting one of the skilled machinists on the staff gave a talk on "Pump Repairs." Full discussion and questioning follow each talk, the talks being given with the blackboard close at hand for graphic illustration. Thirty-three out of thirty-five station employees have joined the "Welco" Club, and the prospects of a good winter's work are bright. In the near future talks will be given on the policies and methods of the company by President R. W. Rollins and Assistant General Manager Fred H. Smith.

Lighting Company Not to Blame if Street Lights Go Out.—Justice Lamothe of the Montreal courts, in deciding that the Montreal Light, Heat & Power Company is not to blame if a street light is extinguished, held that often what are technically known as outages are due to unavoidable causes.

Dinner to Wireless-Telephone Engineers—The men who arranged the recent international wireless-telephone test were entertained at dinner on Dec. 29 by President H. B. Thayer of the Western Electric Company as a testimonial to their services. On the ends of the speakers' table were fac-simile reproductions of the Arlington Naval Station, from which the wireless messages were sent, and the Eiffel Tower at Paris, where the messages were received in France.

Street-Lighting Bond Issue Passes Milwaukee Council.—On Dec. 30 the City Council of Milwaukee approved the 1916 budget, which included a $750,000 bond issue for the establishment of a municipally owned street-lighting distribution system. Authorization of the bond issue has been fought strenuously by the local taxpayers' league and by other interests. According to the present plan, energy for operating the system will be purchased by the city from the Milwaukee Electric Railway & Light Company.

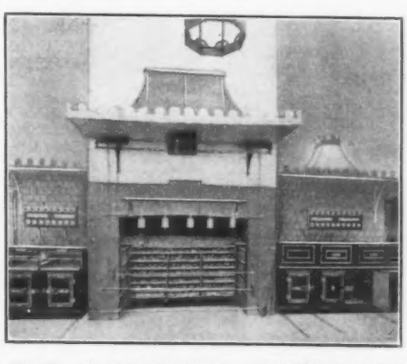
New Home for San Francisco Section, N. E. L. A.—The "Pacific Service" Section of the National Electric Light Association in San Francisco is to have a new and permanent headquarters on property of the Pacific Gas & Electric Company, which is now a part of the Exposition area. The property owned by the company includes parts of the site now occupied by the Service Building, Festival Hall and the adjacent fire station. Plans which have been approved for preserving and remodeling the fire station as an association building include provision for a theater, lounging rooms for both men and women visitors, and sleeping accommodations for members who may have far to travel to attend the meetings.

World's Production of Platinum.—In 1914 the United States produced 570 oz. of crude and 525 oz. of refined platinum from placer sands and 110 oz. from deep mines. In all 3430 oz. of refined platinum were recovered in 1914 from the electrolytic refining of gold bullion, platinum sands and copper matte, of which probably 2500 oz. came from domestic sources. During 1914 about 70,000 oz. of platinum, having a value of $2,908,000, was imported into the United States. This was about 42 per cent below the 1913 import, and indicates the extent to which the world is dependent on Russia for platinum. Russia produces about 90 per cent of the platinum of the world, and Colombia, South America, the next largest producer, about 6 per cent. In former years platinum was considered essential in electrical work, where it is now replaced by "nichrome" and other alloys of metallic molybdenum and tungsten.

San Francisco Considers Transplanting Exposition Lighting Units.—At a recent meeting of the Board of Supervisors of San Francisco a resolution was adopted which recommended to the consideration of the city's bureau of consulting architects the use of some of the lighting equipment from the Exposition for decorative lighting of the structures in the new civic center. The use of the heraldic lighting standards is suggested for illuminating the façades of the buildings, while searchlights could be used for the dome of the city hall. If the scheme were carried out as recommended, the resolution states, it would result in making "the civic center when completed an object of interest and attraction unique on the American continent."

Three-Wire Trolley System for Springfield, Mass.—The three-wire overhead-trolley system of distribution will shortly be adopted by the Springfield (Mass.) Street Railway, according to a statement issued by President C. V. Wood. The United States Bureau of Standards and the Stone & Webster Engineering Corporation recently investigated the electrolysis situation at Springfield, and both reports recommended the sectionalizing of the trolley into alternate positive and negative portions and the virtual elimination of the rail return. It was found desirable to adopt this system rather than to change over the plant for alternating-current transmission to substations. Reconstruction work will begin at once under the general direction of the Bureau of Standards.

Former Royal Residence Fitted with Electric Ranges.—The pavilion in which the kitchen illustrated below is situated was erected at Brighton, England, as a royal residence for King George IV, when Prince of Wales, between the years 1784 and 1786, and was subsequently purchased, at a cost of over $250,000, by the Brighton Town Commissioners, who have recently had it restored as far as possible to its original condition. The principal rooms are now used by the Mayor and Corporation as state apartments on public occasions. When not so engaged, these rooms are hired for balls, receptions and similar affairs. The work of restoration is evident in the kitchen with its huge roasting oven, the only modern note being the two electric ranges.



HUGE OLD-FASHIONED ROASTING OVEN FLANKED WITH ELECTRIC RANGES

Louisville to Trim Trees, Charging Utilities Therefor.—Any trimming of trees on the streets of Louisville hereafter to expedite passage of electric wires will be done by the park commission, which has supervision of all trees in the streets, and the costs will be charged to the utility companies for which the trimming is done, according to a resolution adopted by the city board at its last meeting on complaint of members of civic organizations and individuals. Some time ago an agreement was entered into by the board and the Louisville Gas & Electric Company, by which the park commission was to name a tree trimmer to be paid by the company at $75 a month. It is stated that his services proved unsatisfactory, and the new method does away with the "pruning gangs."

Samuel Insull Gives Engine to University of Illinois.—The College of Engineering of the University of Illinois is to receive from the Commonwealth Edison Company of Chicago, through the courtesy of its president, Samuel Insull, as a museum exhibit, a vertical triple-expansion engine with its directly connected generators and their equipment of transformers, regulators, switches and instruments. This engine, which was one of ten similar units, has a normal rating of 600 hp. and was built in the year 1893 by the Southwark Foundry & Machine Company of Philadelphia, Pa. It was erected during the winter of 1893-4 in the power house of the then existent Chicago Edison Company. Directly connected to the engine, one on each side, were two 200-kw., 150-volt direct-current generators built by the General Electric Company. The Chicago Edison Company later replaced these generators with the present double-current machines, which were among the first of this type of generator built. The unit was put into service on Aug. 1, 1894.

Toronto Rates Lowered.—The Hydro-Electric Power Commission of Ontario has decided upon a reduction in rates to sixty municipalities. The reductions will vary considerably according to the year's showing of the various systems. Several of them, it is stated, are even larger than those to be made effective in Toronto. The new rates in Toronto are as follows: Domestic—3 cents per 100 sq. ft. of floor area per month, plus 2 cents per kw.-hr. for all consumption per month up to 3 kw.-hr. for each 100 sq. ft. of floor area charged, plus 1 cent per kw.-hr. for all additional consumption per month; discount, 10 per cent. Commercial—5 cents per kw-hr. for the first 30 kw.-hr.; 2.5 cents per kw.-hr. for the next 70 kw.-hr.; 0.5 cent per kw.-hr. for all additional consumption per month; discount, 10 per cent. Motor Service—$1.35 per hp. per month of load for first 10 hp.; $1 per hp. per month of load for all over 10 hp.; 1.5 cents per kw.-hr. for first 50 kw.-hr.; 0.5 cents per kw.-hr. for second 50 kw.-hr.; 0.15 cents per kw.-hr. for all additional consumption per month; discount, 20 per cent.

Electrical Supply Jobbers' Association.—The next meeting of the Electrical Supply Jobbers' Association will be held at the Hotel Statler, Detroit, Mich., Feb. 15, 16 and 17.

Buffalo Section, N. E. L. A.—H. Gordon Stott spoke before the Dec. 14 meeting of the Buffalo (N. Y.) Section of the National Electric Light Association on "The Great Engineering Problems of the Panama Canal."

Indianapolis-Lafayette Section, A. I. E. E.—J. W. Stickney was the speaker at the Dec. 17 meeting of the Indianapolis-Lafayette Section of the American Institute of Electrical Engineers. The speaker's topic was the "Past and Future of the Telephone."

Western Society of Engineers.—Samuel Insull, president of the Commonwealth Edison Company of Chicago, will deliver the principal address before the Western Society of Engineers at its annual dinner, to be held at the Hotel Sherman, Chicago, on Jan. 12.

Meeting of Minnesota Contractors in January.—T. W. Findley of the Findley Electric Company, Inc., Minneapolis, Minn., president of the Minnesota Branch of the National Electrical Contractors' Association, has announced that the contractors of the State will meet at St. Paul, Minn., Jan. 20.

Technical Publicity Association.—A meeting of the Technical Publicity Association was held at the Advertising Club, New York City, on Dec. 16. The subjects discussed at this meeting were "Why an Advertising Department?" and "Broadening Its Functions as a Specialized Technical Unit," the speakers being G. M. Rasford, of J. T. Ryerson & Company, and D. R. Wall, of the Splitdorf Electrical Company.

Yale Engineering Association.—At the annual meeting of the Yale Engineering Association held at the Yale Club, New York City, on Dec. 29, the members had the opportunity of listening by long-distance telephone to prominent alumni speaking from San Francisco and Chicago. Edwin M. Herr, president of the Westinghouse Electric & Manufacturing Company, was elected president of the association, and Richard Dana, secretary-treasurer.

New York Jovian League.—A. D. Page, manager of lamp sales of the Edison Lamp Works of the General Electric Company, spoke at the Jan. 5 meeting of the New York Jovian League on the watchword of the organization—"Co-operation." It was announced that J. J. Carty, president of the American Institute of Electrical Engineers, would speak at the next meeting on Jan. 19, and Edward J. Cantell, chief statistician of the city of Philadelphia, on Feb. 16.

A. I. E. E. Meeting in New York.—The 317th meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York City, on Jan. 14, 1916. Dr. Charles P. Steinmetz will be the speaker of the evening and will present a paper entitled "Outline of Theory of Impulse Currents," in which he shows that from the integral of the general differential equation of the electric circuit all types of electric currents are derived as special cases corresponding to particular values of the integration constants. Dr. Steinmetz will supplement the printed paper by an explanation of the general subject as full as the time will permit.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Midwinter Convention of A. I. E. E.—The fourth midwinter convention of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York, Feb. 8 and 9. The Institute convention will be followed by a convention of the Illuminating Engineering Society, in the same building, on Feb. 10 and 11, 1916. These dates were decided upon by co-operation of the two societies for the convenience of members of either society who desire to attend the technical sessions and other events of both conventions, and cordial invitations have been exchanged by the societies.

Washington Society of Engineers.—At the annual meeting of the Washington (D. C.) Society of Engineers, held on Dec. 15 at the Cosmos Club, T. H. Cowling of the United States Reclamation Service gave a lecture on the Yosemite Valley and the Grand Canyon of Colorado. At the business session the following officers were elected: John C. Hoyt, hydraulic engineer for the United States Geodetic Survey, president; A. L. Baldwin of the Coast and Geodetic Survey, vice-president; F. W. Albert of the District Water Department, secretary; C. B. Mirick of the National Electric Company, treasurer, and Elliott Woods, Maurice Hacker and T. M. Taliaferro, directors.

Electrical Credit Men of Chicago Hold Annual Meeting.—At the twentieth annual meeting of the Electrical Credit Association of Chicago the following addresses and papers were presented: "The Chief's Attitude Toward the Association," by W. W. Low of Chicago and W. R. Herstein of Memphis, Tenn.; "The Salesman's Attitude Toward the Association," by A. G. McGivern of Chicago; "Value of Association Service," by G. A. Richard of Watertown, Wis.; "Expansion of the Service," by W. P. Johnson; "House and Departmental Conferences," by C. H. Minor of Chicago; "What Credit Data Should the Salesman Obtain?" by A. H. Powell of Lincoln, Neb., and J. L. Hall of Indianapolis; "Membership Campaigns," by V. G. Fullman of Philadelphia, and "Preparedness," by W. J. Calhoun, ex-Minister to China. Officers for the ensuing year were elected as follows: President, Henry Schwab, Monarch Electric & Wire Company; vice-president, A. O. Keuhmsted, Gregory Electric Company; national representative, F. M. Peirce, Manhattan Electrical Supply Company; secretary and treasurer, Frederic P. Vose; assistant secretary and treasurer, W. S. Vose of Vose & Vose; members of the executive committee, H. O. Clare of the General Electric Company, Thomas I. Stacey of the Electric Appliance Company, and S. E. Kennedy of the Central Electric Company.

Portland Section, N. E. L. A.—At its regular bi-weekly luncheon, held in Portland, Ore., Dec. 23, the Portland Section of the N. E. L. A. and A. I. E. E. had its Christmas celebration. J. E. Davidson of the Pacific Power & Light Company acted as toastmaster, and A. C. McMicken of the Portland Railway, Light & Power Company distributed the gifts, which were of a fun-making nature. The principal speech of the day was by W. H. Galvani, engineer in charge of property and taxation of the Pacific Power & Light Company. The next evening meeting of the Portland Section will be on Jan. 11, at which time the question of inductive interference will be taken up by representatives of the power and telephone companies of Portland.

Missouri Association Appoints Uniform Rules Committee.—The executive committee of the Missouri Association of Public Utilities has authorized the appointment of a committee which is to have full power to act in behalf of the association before the Public Service Commission of Missouri when the latter body shall meet to consider the adoption of uniform rules and standards of service. George E. Hayler, Jr., president of the association, has appointed the following committee: J. D. Bowles, Springfield Gas & Electric Company; F. C. Pratt, Empire District Electric Company, Joplin; John Fay, Union Electric Light & Power Company, St. Louis; S. E. Bronson, Water, Power & Light Company, Ozark, Mo., and A. N. Richardson, Kansas City Electric Light Company.

Program of Ohio Commercial Men's January Meeting.—The following program has been arranged for the meeting of the new-business co-operations committee of the Ohio Electric Light Association at Akron, Ohio, on Jan. 19: Address of welcome, Charles Currie, vice-president and general manager of the Northern Ohio Traction & Light Company; "The Mazda Lamp in Photography," by J. R. Colville of Cleveland; "Electric Furnaces," by J. C. Mathieu of Dayton, and general discussion of the following questions: "Is it good policy to sell appliances on the installment plan?" "What is the best plan of paying central-station salesmen?" "What is the best way to increase minimum-charge customers?" and "How much can the central station afford to pay for old-house business?" The delegates will also visit the plant of the Miller Rubber Company. J. E. North of Springfield will be in charge of the meeting.

FINANCE, COMMERCE AND INDUSTRY

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Manufacturing and Industrial

A Big Field of Opportunity for Reliable Time Switches

Two large Middle Western central-station companies are now engaged in tests which will either prove or disprove that it is economical to place time switches in the substation circuits of large power customers. These companies by metering the energy losses of transformers which are idle each night on these large customers' premises will determine how much waste is actually taking place. Some engineers connected with the experiments claim that the nightly operation of one central-station turbine can be discontinued if transformer losses are stopped in the substations of all the company's large day-power customers. Others think it will lead to the adoption of a new form of power contract for large users in which the hours between which energy is to be available will be specified. The most enthusiastic commentators on the experiments are the time-switch manufacturers, who say they are now making apparatus sufficiently reliable for this service and who see possibilities of a broadened market for their products.

One Million Dollars for Electric Ranges in 1916

Through interviews with electric range manufacturers and through information coming from central-station companies data have been obtained which make it possible to prophesy what will be the extent of the electric range business in 1916. All of the range manufacturers are optimistic. Some in their business planning for the coming year are giving evidence of marked enthusiasm. Others are more conservative, and it is on the estimates of this more conservative class that the ELECTRICAL WORLD bases its prophecy. Thinking conservatively, therefore, the conclusion is reached that, at manufacturers' prices, at least $1,000,000 worth of ranges will be sold in 1916.

When the expense of handling is added to a legitimate profit for dealers, is augmented by the cost of necessary additional wiring, and is totaled with the manufacturers' cost, it appears that consumers this year will pay the electrical industry about $1,750,000 for electric ranges and for their necessary equipment. Such a sum of money is a considerable amount for a business yet in its infancy to bring to its parent industry.

Considering, again conservatively, that the energy for operating these ranges costs $3 a month a range, it may be easily estimated that the additional revenue accruing to central-station companies from the ranges placed in operation in 1916 will amount to $180,000 annually. Viewing the situation from this angle, it seems that central stations which are failing to promote electric cooking energetically are missing a golden opportunity.

The Railway & Industrial Engineering Company, Greensburg, Pa., has moved its sales office in Pittsburgh, Pa., to the People's Bank Building.

H. E. Walker, who for a number of years has represented the S. K. F. Ball Bearing Company, New York, as railway representative, has resigned from that organization. Mr. Walker's plans for the future have not been announced.

The Electric Controller & Manufacturing Company of Cleveland, Ohio, recognized the good service of its employees by the distribution of an amount of cash among them at New Year's amounting to something like 5 per cent of the past year's earnings.

The Electric Panelboard Company, Rochester, N. Y., was recently formed and is engaged in the manufacture of panelboards, switchboards and cabinets. J. B. Tucker is president and treasurer, W. J. Pierce vice-president, and C. T. McDonald secretary.

The Electric Storage Battery Company, Philadelphia, Pa., has appointed G. R. Murphy soliciting agent, with offices in the Rialto Building, 118 New Montgomery Street, San Francisco, Cal., in charge of its Pacific Coast territory, to succeed Pierson, Roeding & Company, who have been the company's sales agents on the Coast since 1910.

Increase in Price of Quicksilver.—The wholesale price of quicksilver has been advancing rapidly of late. On Dec. 29 there was an advance of $10 per flask of 76.5 lb., making the price $140, and again on Dec. 30 a further increase of $10. The average price of quicksilver in 1914 was $48.31 per flask, while the average price for the last ten years has been $43.71.

The Arthur Jones Electric Company, which recently moved from 223 South Clinton Street to 55 East Twenty-eighth Street, Chicago, Ill., as already noted in the ELECTRICAL WORLD of Dec. 11, 1915, is dealing in both new and second-hand electrical machinery and is also maintaining a repair department. On Dec. 1 the company organized a new department for electrical equipment for both gasoline cars and electric vehicles. A storage-battery station is maintained in connection with this department.

Big Year for General Electric Company.—It is reported that the business of the General Electric Company, Schenectady, N. Y., for 1915 is close to $100,000,000 (exclusive of war orders), which is the largest total for the company outside of 1913, when orders were received for $111,819,142, and 1912, when orders were received for $102,934,788 worth of goods. Judging from present indications, the business in 1916 will be far in excess of that of any previous year. The demand for electrical machinery in the past few weeks from various public-service concerns and industrial companies, it is stated, has been considerable.

Cutler-Hammer Employees Have Christmas Party.—Twenty-five hundred people, representing 1400 employees of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., and their families, were entertained at a Christmas party on Dec. 22 by an entertainment committee consisting entirely of employees of the company. An entertainment given early in November was so successful financially as to make it possible for the committee to provide the Christmas party at no cost to employees and their families. Music for dancing was provided by an orchestra composed entirely of Cutler-Hammer employees. Six hundred pounds of candy and many small gifts were distributed to a thousand children present.

Youngstown Sheet & Tube Company Announces 5 Per Cent Profit-Sharing Distribution.—The Youngstown (Ohio) Sheet & Tube Company has just announced that a profit-sharing distribution will be made in the near future on 5 per cent of the earnings for 1915 of employees eligible under the company's profit-sharing plan. The amount distributed will be approximately $350,000, and about 9000 men will be affected. This profit-sharing plan has been in operation since 1909, and in 1910 the first distribution of 5 per cent was paid. In 1913 the distribution was 5 per cent and in 1914 3 per cent. The payment authorized for 1915 will be made as soon as the clerical work can be completed, which will probably be the second pay period in March. It will be of special interest this year, since the company has already appropriated about $8,000,000 for extensions made in the past year, some of which are now approaching completion. Included in the additions are new bar mills, a

coke-oven battery of 204 Koppers ovens, an additional blast furnace, office building, emergency hospitals, laboratories building, additional open-hearth furnaces, and other mill extensions which will increase the annual output of steel about 300,000 tons.

Interest in Electric-Cooking Apparatus Growing in Pacific Coast Territory.—According to H. D. Munger, salesman for the Hughes Electric Heating Company of Chicago, who has spent the last two months in various parts of the Pacific Coast territory, a rapidly increasing interest among companies in this section is being evinced in electric cooking and baking as an outlet for the sale of central-station energy. Many of the companies, he reports, are organizing aggressive sales campaigns for the coming season. An order which includes some Hughes equipment has recently been placed by the Board of Education of Salt Lake City with the Utah Power & Light Company for use in the domestic-science departments of three of the city's graded public schools. The cooking equipment of these departments will be exclusively electric and will consist of twenty-four Hughes No. 10 hot-plates provided with three-heat control and 1100-watt heating units and two No. 74 General Electric ovens for each school. The order also includes a special 10-gal. soup boiler, the walls of which are insulated and which is heated by a 4.5-kw. immersion heater. The kettle will be utilized in preparing soup for the pupils' luncheons. If the kettle proves successful, it is expected that more will be used.

Electrochemical Expansion at Niagara Falls.—Prosperity in the field of electricity is evidenced by building permits granted for additions, alterations and other improvements to the electrical and allied companies in Niagara Falls, N. Y. The Castner Electrolytic Chemical Company recently purchased a structure as an addition to its plant on the upper river and is contemplating the erection of another big addition. The E. I. du Pont de Nemours Company, which recently came to the Cataract City, contracted for ten buildings at a cost of $150,000, then added another costing $25,000, and is now receiving estimates on four other strucures. The company will begin operations within the next ten days, employing upward of 200 men. The plant of the Hooker Electro-Chemical Company, which will supply a by-product to the du Pont company, has awarded contracts for a large addition to its plant to cost upward of $150,000. The Aluminum Company of America plans a large addition to its No. 3 plant, and the Carborundum, the Norton, the Acheson Graphite, the Star Electric, the Oldbury Chemical, the Niagara Bleaching Gas, the Niagara Electro-Chemical and other companies in the upper electrical district are making additions and extensions costing from $20,000 upward.

Increasing Demand for Fault-Locating Apparatus.—Following the publication of articles in the ELECTRICAL WORLD on Sept. 11 and 18, 1915, describing the Vahey fault-locating apparatus for electrical distribution systems, the Lundin Electric & Machine Company, Boston, Mass., reports a steadily increasing demand for this equipment. Beginning with a few installations in Massachusetts, the apparatus has now been adopted by central stations in more distant parts of New England and in the Middle West, and inquiries are being received from other quarters. One recent inquiry presumably due to the ELECTRICAL WORLD articles came from the Canary Islands. About two dozen sets have now been sold. A notable installation was recently made by the Connecticut River Transmission Company, the largest transmission system in New England, after a six weeks' test which proved the usefulness of the equipment in certain classes of trouble hunting on 66,000-volt lines. The Worcester (Mass.) Electric Light Company and other central stations are also recent customers. The Lundin company is about to published a condensed illustrated manual of operation which will make the use of the equipment still easier for the lineman without special technical training. J. F. Beedle of the company told a representative of the ELECTRICAL WORLD last week that the outlook for 1916 in the marketing of this apparatus is most encouraging.

Expansion of Robertson-Cataract Electric Company.—The sixth annual so-called "ginger dinner" of the Robertson-Cataract Electric Company, electric jobber of Buffalo, N. Y., held at the Ellicott Club, proved to be the most successful in the company's career. Incidentally it was the birthday of J. D. Robertson, president of the company, and he was surprised by a present of an imposing birthday cake. William E. Robertson, general manager of the company, made the presentation speech. He also presided at the banquet and acted as toastmaster. Everyone connected with the organization was present, from the general manager down to the newest office boy. Despite the fire which completely destroyed the company's offices, warehouse, storerooms, etc., on the night of Aug. 26 last, the company had a very successful year. It was perhaps the best evidence of its prosperity that the speakers could laugh at the expensive blaze, which forced the company to change its offices three times within as many days. Now the company is building a duplicate to the four-story building it has used as a factory and warehouse at South Elmwood Avenue and Mohawk Street. General Manager Robertson announced that the company would move into the new structure May 1. It is at present established in the Curtis Building, at Franklin and West Huron Streets, occupying the entire ground floor and part of the upper floors as executive offices and shipping rooms. Among those who made informal remarks at the dinner were D. F. Potter, manager of the apparatus department; F. R. Morris, sales manager; W. M. Mashinter, factory manager; K. M. Palmer, credit manager, and B. W. Clark, advertising manager.

Small Single-Phase Motor Meeting with Favor.—According to R. J. Russell, secretary of the Century Electric Company, St. Louis, Mo., the demand on the part of central-station operators in the past few years for a single-phase motor which would require less starting current than the split-phase motor, and thus make it possible to maintain good voltage regulation on secondary circuits without the installation of an abnormal amount of copper, prompted the Century company to begin some years ago to develop smaller sizes of repulsion-induction motors than it had been manufacturing. The beginning of 1915 witnessed the first real introduction of these motors to the market and the commencement of their application in fair quantities to various classes of machinery, with the result that the motor is now being used in sizes with ratings of 1/6 hp., 1/8 hp. and 1/10 hp. as regular equipment by a large number of manufacturers of machines which are started frequently, among these being carbonators, beer pumps, coffee mills, house pumps, small air compressors, bread-wrapping machinery, etc. These small motors are advantageous, Mr. Russell states, because of the fact that the starting torque is more than three times full-load torque and starting current less than three times full-load current, making it possible to start so quickly that most of the machines driven by the motors require a fuse of the same size only as that needed to protect the motor while operating with full load. Use is made of a radial type of commutator brushes bearing on the commutator only during the period of starting. When the motor is accelerated to a speed closely approaching the full-load speed of the motor the governor acts, taking the tension off the brushes and short-circuiting the commutator.

NEW YORK METAL MARKET PRICES

	Dec. 28 Selling Prices Bid	Dec. 28 Selling Prices Asked	Jan. 4 Selling Prices Bid	Jan. 4 Selling Prices Asked
Copper	£ s d		£ s d	
London, standard spot	85 15 0		87 12 6	
Prime Lake	21.75	to 22.00†	23.00	to 23.50†
Electrolytic	21.75	to 22.00†	23.00	to 23.50†
Casting	20.87½	to 21.12½†	22.00	to 22.50†
Copper wire base	22.75	to 23.25†	24.00	to 24.50†
Lead	5.40		5.75	
Nickel	45.00	to 50.00	45.00	to 50.00
Sheet zinc, f.o.b. smelter	22.00†		23.00†	
Spelter	17.42½	to 17.67½	17.30	to 17.50
Tin, Straits	39.12½		45.00†	
Aluminum, 98 to 99 per cent.	53.00	to 55.00	53.00	to 55.00

OLD METALS

Heavy copper and wire	17.00	to 17.50†	17.50	to 18.00†
Brass, heavy	11.50	to 12.00†	12.00	to 12.25†
Brass, light	9.25	to 9.75†	9.50	to 9.87½†
Lead, heavy	4.75	to 4.87½†	4.75	to 4.87½†
Zinc, scrap	12.50	to 13.00†	12.50	to 13.00†

COPPER EXPORTS

Total tons to Jan. 4 .....

†Nominal.

Corporate and Financial

Consolidated Gas, Electric Light & Power Company, Baltimore, Md.—The company has arranged to issue quarterly statements of earnings, and the first report of this kind will be issued early in January, showing the revenues of the corporation for the last quarter of 1915. Heretofore the company has only issued annual reports covering operations for the fiscal year

Middletown (Ohio) Gas & Electric Company.—The Public Utilities Commission of Ohio has authorized the company to issue $143,700 of 6 per cent preferred stock at not less than 85. The proceeds from the sale of the stock are to be used to reimburse the company's treasury for expenditures made for extensions, to provide funds for new construction, and to discharge certain bonded indebtedness.

Newton (N. J.) Gas & Electric Company.—The Board of Public Utility Commissioners of New Jersey has refused the application of the company for permission to increase its rates and recommends the sale of the property of the company, which has been in the hands of William L. Keplinger, receiver, since August, 1911, through chancery proceedings.

Northern States Power Company, Chicago, Ill.—The board of directors has been increased from nine to fourteen members and the following new members have been elected: S. W. Childs of William P. Bonbright & Company; W. H. Clarke, manager bond department H. M. Byllesby & Company; George H. Harries, president Louisville Gas & Electric Company and president Omaha Electric Light & Power Company; R. F. Pack, general manager Minneapolis General Electric Company; J. H. Roemer, counselor H. M. Byllesby & Company; W. R. Thompson, H. M. Byllesby & Company. The board is now composed of these seven men and H. M. Byllesby, A. S. Huey, Otto E. Osthoff, J. J. O'Brien, R. J. Graf, R. G. Hunt, all of H. M. Byllesby & Company, and F W. Stehr of William P. Bonbright & Company.

Public Service Corporation of New Jersey, Newark, N. J.—It has been voted to increase the dividend on the corporation's stock from 6 to 7 per cent. A dividend for the quarter ended Dec. 31, of 1.75 per cent, has been declared.

Rocky Mountain Hydro-Electric Company, Lyons, Col.—It has been announced that work will start in the spring on a large hydroelectric development on the north fork of the St. Vrain River between Billings and Cabin Creek. Capital to finance the development, which it is estimated will cost in excess of $1,000,000, has, it is stated, been secured. Lines will be built to Denver, and from there the energy will be distributed to the surrounding territory.

Southwestern Power & Light Company, New York, N. Y.—This company, a subsidiary of the American Power & Light Company, has issued a sixty-eight-page report giving detailed financial and physical data pertaining to the company and its operating subsidiaries and many photographs of cities and industries served and of properties owned. The company, which through its subsidiaries serves eighty-three communities in Texas and two in Mexico, has had a large growth since its organization on July 30, 1912. The properties then controlled had annual gross earnings of $580,867, as compared with $3,241,961 for the twelve months ended Oct. 31, 1915. The number of communities served was seven, with a combined population of 84,000, as compared with eighty-five communities now served, with a combined population of approximately 500,000. The total number of customers served in 1912 was 11,739, as compared with a total of 66,495 served on Oct. 31, 1915. When the company was organized there was not a mile of high-voltage transmission line in Texas except that used by the interurban railway companies. Since its organization the operating subsidiaries have built 700 miles of high-voltage transmission lines, a large part of which is of steel-tower, double-circuit construction. A statement of earnings of the company for the twelve months ended Oct. 31, 1915, shows a balance of $766,390 applicable to the payment of interest on the first lien 5 per cent bonds. Interest on these bonds amounted to $93,796. Miscellaneous interest amounted to $55,130, leaving a balance of $617,464 applicable to the payment of dividends on the preferred stock. These dividend payments called for $115,019, leaving a balance after their payment of $502,445.

Standard Gas & Electric Company, Chicago, Ill.—A block of $500,000 6 per cent gold notes is being offered at 91 and interest to net 6.75 per cent. These notes are part of the loan which was recently offered for subscription by the Standard Company.

Western Canada Power Company, Ltd., Vancouver, B. C.—The company in December, 1914, obtained the consent of the holders of its first mortgage bonds to the issue of $1,000,000 of additional first mortgage bonds, increasing the existing authorized issue from $5,000,000 to $6,000,000. Negotiations were in progress for the sale in Great Britain of a considerable block of these additional first mortgage bonds, when the company learned that these bonds could be issued in Great Britain only with the express consent of the treasury board. A formal application was made to the treasury board for permission to sell a part of this new issue in Great Britain, but permission was refused. The company had previously ceased all work of construction, and since that time it has largely devoted its net earnings to meet pressing capital expenditures which had previously been incurred. Under these circumstances the company was unable to raise money to pay the half-yearly interest on the first mortgage bonds which became due and payable on Jan. 1, 1916. For some time negotiations have been pending with a committee representing the holders of the three-year notes, due on March 1, 1916, which are secured by a pledge of the second or refunding mortgage bonds of the company, and this committee has tentatively agreed to convert these notes at par and accrued interest into 7 per cent preference shares of the company, provided, among other things, that the holders of the first mortgage bonds will agree to convert the next two years' interest coupons at par into preference shares of the same issue. This agreement will also involve the raising of approximately $350,000 in cash within a period of two years for the purpose of completing the construction of the third generating unit and providing for other necessary expenditures within said period of two years; and to this sum the holders of the ordinary shares of the company will be asked to contribute by subscriptions to preferred shares of the company at par, payable in installments within two years. In case the proposed financial arrangement can be carried out, the capitalization of the company would stand as follows: First mortgage bonds, $5,000,000; 7 per cent preference shares (approximately), $2,850,000; ordinary shares, $5,000,000. With the expected improvement of industrial conditions in British Columbia at the close of the war, the company believes it should be in a position to earn its fixed charges and a dividend upon its preference shares. As soon as possible the holders of each class of the company's securities will be called together to approve of the tentative arrangements that are now being made.

Western Electric Company of Illinois.—This company has reduced its capital stock from $25,000,000 to $70,000, and removed its official residence from Chicago to New York, as noted in these columns on Nov. 27. In commenting upon the change, Judge C. S. Cutting, counsel for the company, said that the laws of Illinois were too stringent to permit successful operation of corporations like the Western Electric Company.

West Kootenay Power & Light Company, Ltd., Rossland, B. C., Canada.—The annual report of the company for the year ended Aug. 31, 1915, shows a net decrease in revenue of $24,009.58, which was due to the shutting down of the copper mines served by the company on account of the demoralized condition of the copper market. These mines, however, with one exception, now are taking their full load again. The earnings of the company for the year ended Aug. 31, 1915, were as follows:

Gross revenue	$388,193
Operating expenses, maintenance and repairs	106,296
Net revenue	$281,897
Bond interest, sinking fund and premium	122,992
Balance	$158,905
Dividends	128,000
Balance	$30,905
Adjustments	1,327
Surplus	$29,578
Surplus brought forward	307,062
Total surplus	$331,640

New Utility and Industrial Companies

The Dacoma Light & Power Company of Dacoma, Okla., has been incorporated with a capital stock of $3,000 by Levi O. LeDou, G. E. Selfridge and others.

The Union Light & Power Company of Augusta, Me., has been chartered with a capital stock of $50,000 by Ernest L. McLean, Frank E. Southard and others.

The Marshall Electric Light & Power Company of Marshall, Wis., has been incorporated wth a capital stock of $10,000 by R. J. Buss, J. D. Meyers and others.

The Chafee Electric Corporation of Chafee, N. Y., has been organized with a capital stock of $5,000 by A. J. O'Dell, R. B. Fisher, J. G. Allen, R. S. Allen and C. W. Hillman.

The Melton Electric Company of Henderson, Ky., has been incorporated with a capital stock of $2,000. The incorporators are M. C. Melton, R. A. Day and E. W. Melton.

The Saline Electric Company of Eldorado, Ill., has been incorporated by J. J. Frey, Charles A. Ramsey, Guy C. Lane and Wiley F. Core. The company is capitalized at $2,500.

The Comstock Electric Company of High Point, N. C., has been chartered with a capital stock of $20,000 to deal in electrical appliances. The incorporators are C. W. Comstock, R. L. Comstock and H. A. Miller.

The Atwood-Lee Company of Wasco, Ore., has been incorporated by Walter A. May, W. H. Lee and L. D. Robinson. The company is capitalized at $15,000 and will furnish electricity for lamps and motors in Wasco.

The Dupo Electric Light & Power Company of Dupo, Ill., has been incorporated with a capital stock of $5,000 to supply electricity in Dupo. The incorporators are J. L. Burnett, L. J. Dyroff and W. A. Schwartztrauber.

The Rotary Electric Sign Company of Chicago, Ill., has been chartered with a capital stock of $10,000 to manufacture and deal in electric signs and electrical appliances. The incorporators are P. M. Gunnell, T. Carlson and Harold J. Finder.

The Kanthro Chandelier Company of Chicago, Ill., has been incorporated with a capital stock of $2,500 by Harry W. Rosenbloom, Samuel Spitzer and Mary Wolf. The company intends to manufacture and deal in electrical and gas fixtures and appliances.

The Moore Development Company of Nashville, Tenn., has been chartered with a capital stock of $10,000 by J. C. Collins, J. S. Neely and others. The company purposes to construct a hydroelectric plant in connection with certain Tennessee property.

The Oakland Electric Talking Sign Company of Chicago, Ill., has been incorporated by Thomas Korwin, F. C. Otis and H. B. Houck. The company is capitalized at $70,000 and purposes to manufacture and deal in machinery and equipment for advertising purposes.

The Welsch Manufacturing Company of Indianapolis, Ind., has been incorporated with a capital stock of $50,000 to manufacture electrical appliances, mechanical and other devices. The directors are John H. Welsh, Joseph L. Gasper and Lewis S. MacEnamey.

The Nesco Corporation of New York, N. Y., has been incorporated by J. P. Nolan, I. and R. A. Manes, 7 Manhattan Avenue, New York. The company is capitalized at $25,000 and intends to manufacture and deal in electrical supplies, packing rubber goods, engineering supplies, etc.

The Sanborn-Pekin Power Company of Sanborn, N. Y., has been incorporated by Henry B. Treichler, J. B. Hudson, W. L. Hudson, Ralph W. Casselman and others. The company is capitalized at $10,000 and purposes to supply electricity in towns and villages in Niagara County, including Sanborn, Wilson, Cambria, Wheatfield, Pekin and Lewiston.

The Simplex Magneto Company of Milbrook, N. Y., has been chartered with a capital stock of $50,000 to manufacture magnetos, appliances, etc., for motors. The incorporators are: L. L. Lowy, 317 West Ninety-third Street; W. J. Goldsmith, 652 West End Avenue, New York City, and C. Messerschmidt, 1411 Bedford Avenue, Brooklyn, N. Y.

Trade Publications

Signal-Lamp Caps.—Harvey Hubbell, Inc., Bridgeport, Conn., is sending out an illustrated folder on Hubbell "Signalite" caps.

Oil Switch.—The Condit Electrical Manufacturing Company, Boston, Mass., has published Bulletin No. 401-A, which describes its type ID oil switch.

Graphic Meters.—Bulletin No. 365, published by the Esterline Company, Indianapolis, Ind., contains information on type GH graphic ammeters and voltmeters.

Motor-Driven Ironer.—The American Ironing Machine Company, 166 North Michigan Avenue, Chicago, Ill., has prepared a booklet on its several types of motor-driven ironing machines.

Motor-Operated Ironers.—Bergbom & Roberg, 218 North Jefferson Street, Chicago, Ill., are sending out an illustrated bulletin on their class A and class B "Roma" motor-driven ironing machines.

Underground Construction Tools and Equipment.—T. J. Cope, 3244 North Fifteenth Street, Philadelphia, Pa., has prepared an illustrated bulletin on electrical underground construction tools and equipment.

Oil Engines.—The Bessemer Gas Engine Company, Grove City, Pa., has issued an illustrated catalog which describes and illustrates its type IV single-cylinder and twin-cylinder two-stroke-cycle heavy-construction oil engines.

Electric-Railway Motors.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is sending out Leaflets No. 3765, No. 3833 and No. 3835, on its No. 307-V, No. 306-V and No. 547-A railway motors.

Heavy Conveying Equipment.—The Robins Conveying Belt Company, 13 Park Row, New York, has issued a booklet entitled "January 1916 Reminder," which contains information on belt conveyors, hoisting machinery, coal and ore bridges, etc.

Motors.—The Lincoln Electric Company, East Thirty-eighth Street and Kelley Avenue, Cleveland, Ohio, has prepared catalogs on its type C alternating-current motors, motors for elevator and hoist service, and alternating-current type I mill motors.

Electric Air Heaters.—Several types of electrically operated air heaters which are designed to attain a temperature of 2000 deg. Fahr. are described in a folder issued by the Majestic Electric Development Company, 428 O'Farrell Street, San Francisco, Cal.

Electric-Railway Renewal Parts and Supplies.—Bulletin No. 44,001H, which is a price list of renewal parts and supplies for car equipment, mine locomotives and railway and mine-line material, has just been issued by the General Electric Company, Schenectady, N. Y.

Electric Pumps.—The Deming Company, Salem, Ohio, has prepared a large-sized catalog entitled "Pumping Machinery," which contains information on a number of different types of electrically operated pumps. The company is also sending out a smaller catalog entitled "Water Supply Systems."

Storage Batteries for Electric Vehicles.—The first edition of Bulletin No. 500, on storage batteries for electric commercial vehicles, has recently been prepared by the Edison Storage Battery Company, Orange, N. J. The bulletin is illustrated with views of trucks from practically all of the manufacturers and in a great variety of services.

New Western Electric Year Book.—The second edition of the Western Electric Company's Year Book, known as the "Electrical Supply Year Book for 1916," has just been published. The current book continues the practice of a simple series of list prices upon which a basic discount applies, such a discount indicating to the holder of the catalog his approximate price for all the articles listed. The 1916 book has a stiff light-blue artistically designed cover and differs from the 1915 issue only in that its listings are more complete and comprehensive, the number of pages being 1504 as compared with 1296 last year. One of the features of the present book is a section in which are listed all the sales helps that the company furnishes its agents gratuitously.

New England

PORTSMOUTH, N. H.—The new ornamental street-lighting system to be installed by the Rockingham County Lt. & Pwr. Co. will consist of 43 standards (Cutter No. 21,119), each carrying three 100-watt type "C" lamps, maintained by underground wires. The cost of the posts is estimated at $1,000 and the installation of system at $4,000. F. A. Belden is manager.

LOWELL, MASS.—The City Council is considering the installation of a power plant for the proposed municipal school group in Kirk Street.

SOUTH NORWALK, CONN.—Extensions are contemplated to the municipal electric plant during 1916, including generating apparatus (probably both alternating-current and direct-current), with steam or fuel-oil engine motive power and some distribution equipment; also ornamental street-lighting equipment. Plans have not yet been prepared. A. E. Winchester is general superintendent.

WATERBURY, CONN.—Preparations are being made by the Housatonic Pwr. Co., New Haven, for the installation of a new 10,000-kw. generator at its power station in the West End. The company is also considering the advisability of installing an oil-burning system at the plant, instead of using soft coal for fuel purposes.

Middle Atlantic

ALEXANDRIA BAY, N. Y.—The Village Board has awarded the contract for street-lighting to the Northern New York Utilities, Inc., Watertown. The company will begin work at once on the erection of a transmission line from Clayton to Alexandria Bay.

BUFFALO, N. Y.—The Police Commissioners have awarded the contract for the installation of an electric flashlight automatic police signal system in the Third, Seventh and Eighth precincts to the National Police Signal Co., Buffalo, at $50,000.

ELMIRA, N. Y.—Application has been made to the Public Service Corporation by the Elmira Wtr., Lt. & R. R. Co. for permission to issue $325,000 in capital stock and $100,000 in bonds, the proceeds to be used to purchase the stock of the Elmira Transmission Co., to merge that company with itself and to acquire the property and franchises of the Elmira & Seneca Lake Trac. Co.

ENDICOTT, N. Y.—The Binghamton Ry. Co. will soon rebuild its local station and install a 300-kw., three-phase, 2300-volt motor-generator set and also will rebuild its transmission line in the spring. E. L. Barnes, Endicott, is manager of the light department.

FAIRPORT, N. Y.—The Municipal Commissioners expect to install a water-softening plant for boiler-feed water this spring; also a 72-in. by 16-ft. return tubular boiler for 150 lb. pressure. The installation of a 200-kva. steam-driven generating unit complete is also under consideration. C. J. Sullivan is manager.

MORRISTOWN, N. Y.—The Gregory El. Co. is preparing to erect a transmission line from Heuvelton to Morristown, a distance of 15 miles. At Heuvelton the company will purchase electricity from the Northern Pwr. Co., taken from the transmission line of the St. Lawrence River Pwr. Co. It is expected to have the line completed by April 15. A. W. Gregory is owner.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEW YORK, N. Y.—Bids will be received by William Williams, commissioner of water supply, gas and electricity, Room 2351, Municipal Building, New York, until Jan. 11, as follows: (1) For furnishing automobiles of the two-passenger type with a flare-board body in rear of covered seat; (2) for furnishing 1½-ton motor trucks with bodies and other appurtenances, complete: (3) for furnishing 5-ton motor truck with body and appurtenances complete. Blank forms of bid, proposal and contract including specifications can be obtained at the above office.

NIAGARA FALLS, N. Y.—The Hooker Electrochemical Co. of Niagara Falls is planning to duplicate its plant in the upper milling district, at a cost of about $1,000,000, for which plans have already been prepared.

RENSSELAER, N. Y.—Arrangements are being made by the Albany Southern R. R. Co. for the installation of a new lighting system in Rensselaer. The company has submitted a proposal to the city offering to improve the lighting system and to double the present number of lamps at a cost of about $5,000 per year more than the existing contract. James E. Hewes, Rensselaer, is general manager.

ROCHESTER, N. Y.—Plans are under way by the Rochester Ry. & Lt. Co. for the installation of a 15,000-hp. steam turbine and generator in Station No. 3, at Brown's Race and Mill Street. Contracts, it is understood, have been placed for equipment.

TROY, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 1 for changes in plumbing, conduit and wiring system and lighting fixtures in the United States post office, court house, etc., in Troy. For details see proposal columns.

ALTOONA, PA.—Work has been started on the construction of a building for the power and heating plant for the new Strand Theater, now being erected by Silverman Brothers at Eleventh Avenue and Fifteenth Street. The plant, it is understood, will furnish light, heat and power to the buildings on the entire block.

DUNLO, PA.—Preparations are being made by the Penn Pub. Ser. Co. for remodeling the plant of the Dunlo Ht., Lt. & Pwr. Co., which it recently acquired.

MEDIA, PA.—An appropriation has been made for the installation of an additional engine and generator in the municipal electric-light and water-works plant. Twenty fixtures for type C lamp with compressors will be purchased about Jan. 20. A new sedimentation basin and sterilization plant is now being installed. P. E. Ahern is manager.

PHILADELPHIA, PA.—Bids will soon be asked for the construction of a 10-story brick, stone, cement and steel building for the Pennsylvania Taximeter Co. at 329 to 355 Broad Street, Philadelphia. Carl P. Berger, Philadelphia, is architect.

POMPTON, N. J.—The Pompton Township Committee has adopted a resolution granting the borough of Butler a franchise to furnish electricity from the Butler municipal plant for commercial purposes in the Bloomingdale section.

CENTERVILLE, MD.—The electric light commissioners expect to install a 175-hp. boiler in the municipal electric-light plant some time this year. L. B. Shank is manager.

KERMIT, W. VA.—The contract for installing an electric plant for the Wolf Creek Lumber Co. at Kermit has been awarded to the J. A. Castle El. Co., Huntington.

WHEELING, W. VA.—Plans are being prepared for the construction of a two-story power house, 100 ft. by 100 ft. (to cost about $80,000), for the Block Brothers Tobacco Co. G. Frederick is chief engineer.

WASHINGTON, D. C.—The contract for building the central power station for government buildings in "the White House distrct," planned for several years, has been awarded by the Treasury Department to the W. G. Cornell Co., Washington, D. C., at $1,397,484. The plant will be erected on Water Street at the foot of Fifteenth Street, S. W.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 9167—60,000 ft. portable ship-lighting cable; Schedule 9168—12,000 chemical sounding tubes; Schedule 9166—six electrically operated ice-cream freezers. Philadelphia, Pa., Schedule 9163—furnishing and erecting a passenger and freight elevator. Norfolk, Va., Schedule 9172—6500 steel boiler tubes; Schedule 9181—three electric food grinders. Boston, Mass., Schedule 9172—2000 lb. sheet brass. Portsmouth, N. H., Schedule 9170—2400 lb. rod copper. Washington, D. C., Schedule 9164—9000 lb. sheet copper; Schedule 9169—185,000 lb. hot-rolled or forged carbon steel, 33,500 lb. special carbon steel; Schedule 9165—13 12-in. powder conveyor hoists. Puget Sound, Schedule 9177—miscellaneous pumps, accumulator and accessories. Applications for proposals should designate the schedule desired by number.

North Central

ALLEGAN, MICH.—Arrangements, it is reported, are being made by the Consumers' Pwr. Co., Jackson, to extend its transmission line from Allegan to South Haven, via Fennville, Pullman and Lee. The company has purchased 10 acres of land on the south side of the city on which, it is understood, a new dam across the Kalamazoo River will be built.

CHARLEVOIX, MICH.—The city of Charlevoix is contemplating the erection of a two-phase transmission line 1 mile from the municipal plant, for an auxiliary plant. A. J. Hamilton is superintendent.

DURAND, MICH.—Improvements are contemplated to the municipal electric-light and water plant, including the installation of a 350-hp. engine directly connected to a 250-kw. generator. D. M. Trumbull is secretary.

HUDSON, MICH.—A new company, to be known as the Southern Michigan Lt. & Pwr. Co., has been organized to take over the properties of the Hudson (Mich.) El. Lt. Co. and the Morenci-Fayette Lt. & Pwr. Co., Morenci. The new company will extend the transmission lines to furnish electricity for lamps, heaters and motors in

Reconstruction of Dam No. 3 of the Mammoth Spring (Ark.) Electric Light & Power Company

The accompanying illustrations show respectively the condition of Dam No. 3 of the Mammoth Spring (Ark.) Electric Light & Power Company, situated 3 miles below Mammoth Spring, after the flood of Aug. 20, 1915, and the dam in process of reconstruction. The failure of the core wall was due to the water washing away the earth embankment on each side of it. The river rose to a height of 11 in. over the core wall, and the embankment on the down-stream side was completely washed out, carrying away all of the 124 ft. of core wall. The plant building, which is normally 5 ft. above the tailwater, was filled to a depth of nearly 6 ft. The core wall is being replaced by an Ambursen-type spillway which will have a crest elevation 4 ft. higher than the present spillway and 2 ft. lower than the crest of the former core wall. The lower part of the power house will also be made watertight to a height of 9 ft. above the floor. This plant supplies electricity (transmitted at 33,000 volts) to the cities of Mammoth Spring, Ark., and Thayer, Koshkonong, Brandsville and Westplains, Mo. Emergency service was established in Westplains five days after the storm. A 100-kw. generator was sent from Mammoth Spring and driven by the engine which was displaced when the transmission line was put into operation. Steam was supplied by a nearby ice factory. Meanwhile a temporary water-power plant was installed at Mammoth Spring as soon as the 150-kw. generator was brought from Dam No. 3 and dried out. A few days later Thayer, Koshkonong and Brandsville were supplied. An order has been placed with the Westinghouse El. & Mfg. Co. for a 375-kw. generator, duplicating the present directly connected unit remaining in the power station. A. L. Dabney of Memphis, Tenn., is consulting engineer; E. C. Bellamy is general manager of the Mammoth Spring company, and A. E. Main is electrical engineer.

other towns in southern Michigan and northern Ohio. A building has been purchased in Morenci and a 500-hp. electric generating plant will be installed (in addition to the present plant) under the supervision of Earl Scranton of Hudson. The main office of the company will be in Hudson. The officers of the new company are: George F. Avis, president; Oren Howes, vice-president; Floyd D. Avis, secretary, and C. J. Avis, treasurer.

BUCKLAND, OHIO.—The electric light commission is contemplating the installation of a storage battery in the municipal electric plant for day and night service. E. M. Decker is secretary.

CINCINNATI, OHIO.—A considerable amount of power and electrical equipment will be required by the Roche-Bruner Construction Co., Cincinnati, in carrying out its contract for the construction of the power house, tunnels and other work at the Eastern High School. The amount of the bid was $390,700.

CINCINNATI, OHIO.—Plans are being prepared by the American Machine Tool Co., Cincinnati, for the construction of a new plant, to cost about $400,000, this year. Tentative plans contemplate a building four stories high and 250 ft. square. Large power and electrical units and other mechanical equipment will be required.

CINCINNATI, OHIO.—The construction of a large power station to serve Cincinnati and vicinity for the Union Gas & El. Co., it is reported, has been definitely decided by the directors. The proposed plant will be situated at some point on the Ohio River, but the site has not yet been made public. The Cincinnati Gas & El. Co., which owns the distributing plant now leased to the Union Gas & El. Co., will erect the power plant and lease it to the latter company.

COLUMBUS, OHIO—The capital stock of the Northwestern Ohio Lt. Co., Van Wert, has been increased from $10,000 to $1,000,000.

COLUMBUS, OHIO.—Plans have been completed, it is reported, by H. S. Riddle, superintendent of construction for the Board of Administration, for the new power plant to be erected at the Columbus State Hospital. The cost of the plant is estimated at about $40,000.

GREENWICH, OHIO.—At a special election held last summer it was voted to expend $15,000 for improvements to the water and light plant, including enlarging reservoir, repairing spillway, new pump and lowering pumps and other improvements. F. Daniels is clerk.

LEIPSIC, OHIO.—The Northwestern Ohio Lt. Co., Leipsic, will erect a 13,000-volt transmission line this spring, tying in Ottawa, Leipsic, Deshler and Hoytville. Plants at Ottawa, Leipsic and Deshler are all to be operated. The main power station and office is to be at Leipsic. F. R. Harris is division manager.

NORWOOD, OHIO.—Wiring and other electrical equipment will be included in proposals to be opened by the Norwood Board of Education on Jan. 24 for the construction of a new school building. Plans are on file at the office of Bausmith & Draine, architects, Gerke Building, Cincinnati.

ZANESVILLE, OHIO.—Plans prepared by C. E. Stevens, engineer, of Pittsburgh, Pa., have been adopted by the City Council. Under the proposed plans the city will have 700 nitrogen-filled lamps, as compared with the present 550 arc lamps. On Main Street each post will carry two lamps and will also be used for trolley poles. The standards will have a fancy base. On Market Street an ornamental standard of Corinthian design, carrying a single globe, will be used. The same style will be used on Third, Fifth and Sixth Streets and later on Fourth and Seventh Streets, between Main and Market Streets.

CLAY, KY.—The Clay Ice & Lt. Co. is negotiating with the towns of Providence and Dixon to supply electricity. If the deal goes through the company will erect 14 miles of transmission line and install a 200-kw. generator and engine, discarding the single-phase machine now in use; also a 300-hp. water-tube boiler. C. R. Clark is secretary.

HAZARD, KY.—The Kentucky River Pwr. Co. is now installing additional equipment, including a 750-hp. engine (Pennsylvania Iron Works), one General Electric 500-kw., three-phase, 60-cycle, 2300-volt generator, one 150-hp. return-tubular boiler; is also erecting 10 miles of 2300-volt transmission system and 5 miles of 2300-volt distribution lines. The company expects to take over the municipal and commercial lighting and power business about the first of February. It will begin work on the construction of a steam turbine plant in Hazard in the spring. The proposed equipment will include a 1500-kva. turbo-generator set with two 500-hp. water-tube boilers, automatic stokers, coal and ash handling equipment. A reinforced concrete and brick building, providing space for additional 3000-kva. generating unit and boilers for same, will be erected.

NEWPORT, KY.—The proposal to install an ornamental street-lighting system on various streets in the downtown section of the city is under consideration by the City Commissioners.

PIKEVILLE, KY.—Preparations are being made by the Sandy Valley Lt. & Pwr. Co., Pikeville, to build a new power station, to meet the increasing demands for electrical service.

KNOX, IND.—During the coming year the Knox El. Lt. & Pwr. Co. expects to install a 200-kw. alternating-current generator to be connected to a Corliss engine. The 65-kw. direct-current generator will be taken out. Thomas A. Grist is owner and manager.

JACKSONVILLE, ILL.—The City Council is considering the question of equipping the South End pumping station for electrical operation.

RANKIN, ILL.—The Rankin El. Lt. Co. is installing a 2-ton distilled-water ice plant. Contract for machinery (except motors) has been awarded to the York Mfg. Co., York, Pa. Charles J. Crump is president and manager.

SPRINGFIELD, ILL.—Included in the contract awarded to Frank Fitzsimmons of Springfield for remodeling the State Capitol Building are two electric elevators.

TAMMS, ILL.—The Tamms Ice, Lt. & Fuel Co. has applied for a certificate of convenience and necessity to construct and operate an electric-light and fuel plant in Tamms.

WEST SALEM, ILL.—Application has been made by the West Salem Ice & Lt. Co. for a certificate of convenience and necessity to generate electricity for distribution in West Salem.

DELAVAN, WIS.—The City Council is contemplating the installation of a municipal electric distributing plant. It is proposed to purchase energy to maintain the system.

MANITOWOC, WIS.—The city has voted to consolidate the municipal electric-light plant and water-works pumping station.

WAUWATOSA, WIS.—The project to build a central heating and lighting plant in Wauwatosa (to cost about $355,000) has been revived, it is reported, by the County Board of Control.

CARVER, MINN.—The Minneapolis General El. Co. will extend its transmission line from Chaska to Carver, a distance of 2 miles, to supply electrical service here. T. D. Crocker is assistant general manager.

ISANTI, MINN.—Application has been made to the Village Council by R. P. Allen, manager of the Eastern Minnesota Pwr. Co., Pine City, for a franchise to install an electric-lighting system in Isanti.

LITTLE FALLS, MINN.—The Little Falls Wtr. Pwr. Co. of Minnesota is considering the installation of an additional 1000-kva. generating unit and also the erection of approximately 80 miles of high-tension transmission lines to connect ten or more smaller communities. T. C. Gordon is secretary and treasurer.

WASECA, MINN.—The municipal electric-light plant was badly damaged by fire on Dec. 22.

BIRMINGHAM, IOWA.—A franchise, it is reported, has been granted to the Interstate Pwr. Co., Fairfield, to supply electricity in Birmingham. Energy to operate the system, it is understood, will be secured from the Oakland Mills.

BODE, IOWA.—Bonds have been voted for the installation of a municipal electric-lighting system in Bode. Energy will be obtained from the Humboldt-Livermore transmission line of the Northern Iowa Pwr. Co.

CLEMONS GROVE (not a post office), IOWA.—At an election to be held Jan. 10 the proposal to grant the Iowa Ry. & Ltg. Co., Cedar Rapids, a franchise to construct and operate an electric-light plant in Clemons Grove will be submitted to the voters.

ELMA, IOWA.—Plans are being considered for the erection of a new power station (brick) for the municipal electric plant. E. M. Streitch is manager.

KNOXVILLE, IOWA—During this month the Marion County El. Co. will change its system from 250 volts, three-wire, direct current, to 2300 volts, three-phase, 60 cycles, alternating current. Work is practically completed. The company furnishes electrical service in the towns of Dallas and Melcher. Herbert Bellamy is manager.

NEVADA, IOWA.—Bids will be received by J. R. Larson, secretary of the school board of the independent school district of Nevada, until Jan. 24, for the erection of a high-school building, including general construction, heating and ventilating, plumbing, electrical work, science and laboratory equipment, gymnasium equipment, and seating. Plans and specifications are on file at the office of G. L. Lockhart, architect, 285 Endicott Building, St. Paul, Minn., at the office of the secretary of the school board, Nevada, and at the Builders' Exchanges at Des Moines, Iowa, St. Paul, Minn., and Minneapolis, Minn. Copies of plans may be obtained from the architect upon deposit of $10.

VINTON, IOWA.—The town of Vinton, it is reported, has engaged J. B. Hill, Iowa City, consulting engineer, to take charge of the proposed improvements to the municipal electric-light plant.

JOPLIN, MO.—Plans are being considered by submit a bond issue of $100,000 to the voters for the purpose of enlarging the municipal electric-light plant. Charles A. Patterson is commissioner of public utilities.

MARSHALL, MO.—The installation of an electric-lighting system is reported to be under consideration by the City Council.

PLEASANT HILL, MO.—The Pleasant Hill Lt. & Pwr. Co., it is reported, contemplates the erection of an electric transmission line from Pleasant Hill to Strasburg.

SPRINGFIELD, MO.—Plans are being considered by the board of directors of the Young Men's Christian Association of Springfield for the installation of an independent electric-light plant in its building. A committee, consisting of Rev. J. T. Bacon, C. H. Cole and George G. Helde, has been appointed to make investigations.

BEACH, N. D.—Arrangements, it is reported, are being made by Leander Greiner, Ollie, for the installation of an electric-lighting plant in Beach.

HETTINGER, N. D.—The town has granted Smith Schmickrouth a franchise to install and operate an electirc lighting and power plant in Hettinger.

KENMARE, N. D.—The property of the Kenmare Lt. & Pwr. Co., it is reported, has been sold to the General Utilities Co. of Fargo.

SURREY, N. D.—Plans are being considered for the installation of an electric-lighting system in Surrey. The Consumers' Pwr. Co., St. Paul, Minn., is said to be interested.

WILLISTON, N. D.—Bids are now being asked by the city of Williston for the installatioin of an ornamental street-lighting system, to cost about $30,000.

OVERTON, NEB.—W. H. Hill, owner of the local electric-light plant, expects to obtain electricity from a transmission line from Kearney, Neb., next spring.

ALTOONA, KAN.—The installation of an electric-light plant in Altoona is under consideration. Frank Adams of Overleese & Askins, Bartlesville, Okla., is reported interested in the project.

BLUE RAPIDS, KAN.—Plans, it is reported, are being considered by the Marshall County Pwr. & Lt. Co., Blue Rapids, for extending its service to nearby towns.

TROY, KAN.—Plans are being considered by the towns of Bendena and Denton for the installation of electric-lighting systems, the service to be supplied from Troy.

Southern States

WAKE FOREST, N. C.—Beginning this month, electricity for operating the municipal electric-lighting system will be obtained from the Carolina Pwr. & Lt. Co., Raleigh. A 24-hour service will be established. J. L. Bullard is superintendent.

WILMINGTON, N. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 25, for installation of a conduit and wiring system, lighting fixtures, etc., at the Unted States post office and custom house at Wilmington, N. C. For details see proposal columns.

GREENVILLE, S. C.—Plans have been prepared by the Southern Pub. Utilities Co., Greenville, for the installation of an ornamental lighting system, consisting of 84 standards mounted with 600-cp. series nitrogen lamps, maintained by overhead wires, to cost about $20,000. Material has already been purchased.

ORANGEBURG, S. C.—Bids will be received by the Mayor and Councilmen of the city of Orangeburg until Feb. 1 for furnishing either one or two engine-driven exciter units, one surface condenser, one jet condenser, one motor-driven triplex pump, complete with switchboard and approximately 300 tons of cast-iron pipe, together with valves, fittings, etc. Further information

may be obtained upon application to James E. Salley, superintendent water and light plant, or to T. O. S. Dibble, city clerk.

BLAKELY, GA.—The municipal street-lighting system is being changed from arc lamps to incandescent lamps. The work will soon be completed. E. R. Adams is superintendent.

LEESBURG, FLA.—Arrangements are being made by the Leesburg Ice Co. to install a 30-ton ice machine for cold-storage system. J. Y. Clark is president and manager.

ORANGE SPRINGS, FLA.—The Florida Farms & Homes Co., Orange Springs, it is reported, is contemplating the installation of an electric-light plant. James R. Murphy, Palatka, is president.

CHATTANOOGA, TENN.—Arrangements have been made by the business men and property owners on East Seventh Street for the installation of an ornamental lighting system (to cost about $5,000) on that thoroughfare. The lamps will be maintained by underground cables. The system will be installed by the Chattanooga Ry. & Lt. Co.

MARYVILLE, TENN.—Preparations are being made by the Aluminum Co. of America, Pittsburgh, Pa., to begin work by May 1 on the construction of the first dam in connection with hydroelectric developments on the Little Tennessee River. The first in a series of dams will be built at Alcoa and will be 185 ft. high. The company has riparian rights on 40 miles of Little Tennessee River, it is said, capable of developing a maximum of 400,000 hp. The company now obtains energy from the Ocoee River plant of the Knoxville Pwr. Co. to operate the Maryville aluminum plant. Charles E. Sudler is engineer for the company.

SHARON, TENN.—Bonds to the amount of $25,000 have been voted for the installation of an electric-light plant and water-works system. Of the proceeds $10,000 will be used for the lighting plant.

BIRMINGHAM, ALA.—The Alabama Pwr. Co., Birmingham, will have its transmission lines completed to Tuscaloosa by Feb. 1, and connection made with the Tuscaloosa Ry. & Utilities Co., which will distribute the power. Plans for extending the lines of the Alabama company into Walker County have been completed, and it is expected that work will begin in a few weeks. The lines will first run to Cordova. It is understood that extensions will be made immediately to Jasper and other cities.

FAIRHOPE, ALA.—At an election to be held Jan. 10 the proposal to issue bonds for the installation of an electric-light plant will be submitted to the voters. Xavier A. Kramer, Magnolia, Miss., is engineer.

MOULTON, ALA.—The installation of an electric-light plant in connection with the Moulton water-works system is under consideration. H. C. Dunn is general manager.

NEW DECATUR, ALA.—The installation of a municipal electric-light plant is under consideration by the City Council.

CLARKSDALE, MISS.—Bids will be received by the Commissioners of Clarksdale until Jan. 18 for construction of power station and for furnishing certain equipment for same, and for erecting certain other equipment already purchased for the Clarksdale electric-light and water-works plant. Plans and specifications may be seen at the office of the city clerk, Clarksdale, or copies may be obtained at the office of the W. G. Shurgar Engineering Co., Meridian, Miss., upon receipt of $3 to cover cost of printing, etc. M. W. Purnell.

COLUMBUS, MISS.—An election will soon be called to submit to the voters the proposal to issue $10,000 in bonds to establish a municipal electric-light plant in Columbus.

GRENADA, MISS.—Within the next six months the Municipal Light and Water Department expects to install an ornamental lighting system on the principal streets of the city. H. C. West is superintendent.

ITTA BEND, MISS.—Bonds to the amount of $20,000, it is reported, have been voted for the installation of an electric-light plant.

PONTOTOC, MISS.—The Pontotoc El. Lt. & Pwr. Co. will change its system from single-phase to three-phase and install a 60-kw., three-phase generator, to be driven by the present steam engine in the plant, and will also install a 50-hp. oil engine and a 40-kva., three-phase generator; new switchboards will also be installed. The establishment of a 24-hour service is contemplated. The Pontotoc Water Works Co. will install a water-works system in Pontotoc and will purchase energy from the Pontotoc El. Co. to operate the pumping station. L. E. Price is owner and manager of the electric plant.

MORRILLTON, ARK.—The property of the Morrillton Lt. & Pwr. Co. was taken over by the Arkansas Lt. & Pwr. Co. on Nov. 1, 1915. The power station will be rebuilt and new equipment installed, including engines, generators and boilers. The distribution system will be rebuilt this year. The company will also erect 6 miles of transmission lines to connect Plumerville in February or March. The main office of the company is located in Arkadelphia, Ark. J. F. Mullins is local manager.

PARAGOULD, ARK.—Plans are being considered, it is reported, by the Arkansas Lt. & Pwr. Co., Arkadelphia, to remodel the local plant and install a turbine engine and condenser, etc.

FRANKLINTON, LA.—The Hood Lt. Co., Franklinton, is installing equipment to operate its plant by water-power.

NEW ORLEANS, LA.—The proposal submitted by the New Orleans Ry. & Lt. Co. in regard to electric-lighting rates has been accepted by the City Council. The company has also agreed to install a new street-lighting system, at an estimated cost of $160,000.

OPELOUSAS, LA.—Bids will be received by the Mayor and Board of Aldermen, Opelousas, until Jan. 18, for rebuilding of the electric-light and water-works plant that was destroyed by fire on Oct. 28, 1915, and for the purchase of one 150-hp. crude-oil engine directly connected to a 100-kva. alternator, one generator panel, one automatic voltage regulator, three series incandescent regulators and transformers, 40 electric meters and 200 water meters. Plans for building can be obtained from T. G. Chachere, architect, Opelousas, upon deposit of $10. Specifications for machinery may be obtained, without deposit, from A. C. Jones, Opelousas, superintendent of the municipal plant.

GOLTRY, OKLA.—Bonds to the amount of $15,000 have been voted to establish a municipal electric plant and acquire a telephone system. W. L. Benham, Oklahoma City, is engineer.

LAWTON, OKLA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 25, for installing an electric passenger elevator in the United States post office at Lawton, Okla., and McCook, Neb.

MARSHALL, OKLA.—The contract for the construction of an electric-light plant and water-works system, it is reported, has been awarded to F. W. Keeney & Co., Oklahoma City. The cost is estimated at about $20,000.

SHAMROCK, OKLA.—The Oil Fields Gas & El. Co., recently incorporated with a capital stock of $200,000, proposes to construct an electric generating station to supply electricity to operate railways, lighting system and for power purposes. The plant will be erected under the supervision of S. W. Barnes, Kansas City, Mo. The company is affiliated with the Sapulpa & Oil Field Ry. Co. Most of the machinery, it is understood, has been purchased. Among the incorporators are S. W. Barnes, of the Westinghouse El. & Mfg. Co., J. A. Frates of the Frisco Lines of Springfield, Mo., C. F. Hopkins of Sapulpa, and others.

WELCHES, OKLA.—The proposal to issue bonds for the installation of an electric-lighting plant in Welches, we are informed, did not carry. Reported in the issue of Dec. 18 that $8,000 in bonds was voted for lighting plant. S. M. Booton is clerk.

BEEVILLE, TEX.—Improvements are contemplated to the local plant of the Texas Southern El. Co., including the installation of a 125-kw. generator and engine. F. C. Greer is local manager.

CENTER, TEX.—The property of the Pittman Ice & El. Co., Center, is reported to have been purchased by the Texas Southern El. Co., Houston. Improvements, it is understood, will be made to the plant, including the installation of new machinery and rebuilding of distribution system.

CLAUDE, TEX.—The city of Claude, it is reported, is ready to grant a franchise for an electric-light plant and water-works system. For further information address Board of City Development.

TEMPLE, TEX.—The city water commissioners have decided to adopt electricity at the water-works pumping station. A new motor-driven pump will be purchased. The present steam plant will be used as an auxiliary.

Pacific States

ELLENSBURG, WASH.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 27, for construction, including mechanical equipment and approaches, of the United States post office at Ellensburg, Wash.

PROSSER, WASH.—Preliminary surveys have been completed for a dam on the Yakima River for the proposed municipal electric light and power plant for Prosser. Estimates of cost of plant, transmission lines and distributing system will soon be submitted to the Council. Should the Council approve the recommendations, a special election will be called to vote on a bond issue for construction, and the plant will be built during 1916.

DURHAM, CAL.—The Durham Lt. & Pwr. Co. is contemplating the erection of 3 miles of 11,000-volt transmission line early in the spring and will require poles, wire, transformers, pole hardware, etc. The company is considering using steel or iron poles instead of wooden poles. It is also considering inaugurating a campaign for the use of heating and cooking utensils. J. A. Foster is manager.

OCEANSIDE, CAL.—The Oceanside El. & Gas Co. contemplates the installation of a new pump for 125-hp. and 70-hp. horizontal tubular boilers and a new 4-in. centrifugal pump for pumping water from the ocean, 16-in. to 18-in. vacuum pull, 10-ft. lift (estimated 48-ft. head). The company is also arranging for day service for one day a week to supply electricity for electric irons.

PASADENA, CAL.—The installation of a 3000-kw. turbine in the municipal electric-light plant has just been completed. C. W. Koiner is general manager.

CALDWELL, IDAHO.—The Caldwell Trac. Co. is planning to equip for electrical operation the Wilder Branch of the Oregon Short Line R. R. Co. (11 miles long), recently leased to it.

MACKAY, IDAHO.—The Mackay Lt. & Pwr. Co. is installing a 220-hp. Pelton impulse waterwheel. J. D. Carr is manager.

TWIN FALLS, IDAHO.—All the property owned by the Great Shoshone & Twin Falls Wtr. Pwr. Co., including lands, power plants, power sites, transmission lines, etc., will be sold under foreclosure and receivership proceedings by Van W. Hasbrouck, special master of the United States District Court, on Jan. 8. The sale, it is understood, will be followed by the absorption of the Great Shoshone company by the Electric Investment Co.

PALAMOS, ARIZ.—S. H. Woodruff, Los Angeles, Cal., and associates plan to utilize the underflow of the Gila River, near Palamos, to reclaim a large tract of land by means of irrigation. Electrically operated pumps will be installed in connection with a number of large wells that will be dug in the dry bed of the river to lift the water to the surface.

CANON CITY, COL.—The Arkansas Valley Ry., Lt. & Pwr. Co., Pueblo, will build an addition to its local plant and increase the generating capacity by 7500 kw., complete with boilers, one turbine and necessary transformers, and will also erect 23 miles of 22,000-volt transmission line. The work will be done under the direction of H. M. Byllesby & Co., 206 South La Salle Street, Chicago, Ill. W. N. Clark is local superintendent.

DENVER, COL.—Arrangements are being made by business men and property owners on Champa Street for the installation of an ornamental street-lighting system on that thoroughfare.

STERLING, COL.—The Sterling Consol. El. Co. is contemplating the installation of a 19-in. by 24-in. Chase uniflow engine directly connected to a 250-kva., three-phase, 2300-volt alternator. H. L. Titus is manager.

Canada

HALIFAX, N. S.—Extensions, it is reported, are contemplated by the Halifax Tramway Co. to its power system, involving an expenditure of about $500,000. The additions will include a complete gas plant having a capacity of 600,000 cu. ft., with provision for further extensions. A machine shop, 146 ft. by 150 ft., will also be erected.

HALIFAX, N. S.—The Board of Public Utilities has denied the application of the Nova Scotia Lt. & Pwr. Co. to increase its capital stock from $6,000,000 to $12,000,000, the amount required to finance the scheme proposed for using the Gaspereaux power and the acquirement of the property of the Halifax El. Tramway Co. The refusal was made on the ground that the company had not been organized and therefore could not pass a vote of the shareholders authorizing the increase of capital as required by the charter.

PORT ELGIN, ONT.—A by-lay authorizing the installation of a hydroelectric system in Port Elgin will be submitted to the ratepayers.

WATFORD, ONT.—Plans, it is reported, are being considered for the use of hydroelectric power and for installation of a distribution system to cost about $10,000. W. S. Fuller, Watford, is interested in the project.

1,165,383. Elevator Indicator System; F. A. Boedtcher, Bergenfield, N. J. App. filed Feb. 21, 1914. Hoisting drum can be moved without deranging the indicator.

1,165,412. System of Aeroplane Signaling; H. M. Horton, New York, N. Y. App. filed Oct. 15, 1910. Complete sending and receiving equipment carried by aeroplane.

1,165,418. Controlling Electric-Generator Prime Movers; T. H. Kerr, Pittsburgh, Pa. App. filed Oct. 11, 1913. State of charge of battery controls prime mover which operates generator.

1,165,420. Municipal Service Post; O. D. Kleinsteuber, Milwaukee, Wis. App. filed Oct. 30, 1914. For fire-alarm, police and telephone apparatus.

1,165,447. Switch-Controller System; F. N. Reeves, Newark, N. J., and A. E. Lundell, New York, N. Y. App. filed Dec. 12, 1914. For telephone exchanges.

1,165,451. Electric Heating Element; E. H. Ruckle, Chicago, Ill. App. filed Dec. 23, 1914. For broilers and the like.

1,165,454. Apparatus for Receiving and Strengthening Electric Oscillations; J. Schiessler, Baden, Austria-Hungary. App. filed Nov. 23, 1910. For both wire and wireless telephony and telegraphy.

1,165,479. Electric Switch; A. R. Wittwer, Sabatha, Kan. App. filed Sept. 28, 1914. Permutation type.

1,165,492. Dual Ignition System for Internal-Combustion Motors; E. A. Briggs, Hopewell, N. J. App. filed April 14, 1915. Design for Ford automobiles.

1,165,519. Spring Binding Post; D. K. Kuskin, New York, N. Y. App. filed July 25, 1913. For dry cells.

1,165,542. Electric Door Lock; O. B. Schnerre, Galena, Ill. App. filed Oct. 18, 1913. Key-controlled; electrically operated.

1,165,553. Electrical Connecting Socket; J. C. Stearns, Worcester, Mass. App. filed March 19, 1915. For mounting in automobile lamps.

1,165,558. Method of Producing Electromagnetic Coils; C. H. Thordarson, Chicago, Ill. App. filed Jan. 11, 1915. From thin, narrow, flat wires.

1,165,563. Electrical Fuse; H. W. Young, Chicago, Ill. App. filed March 25, 1914. Cartridge type.

1,165,572. Junction Box and Switch; F. A. Culver, Worcester, Mass. App. filed Jan. 16, 1912. For use on automobiles.

1,165,596. Magneto-Electric Machine; O. Heins, New York, N. Y. App. filed Jan. 22, 1915. Reversible; for small motors.

1,165,601. Electrical Ignition Device; G. Honold, Stuttgart, Germany. App. filed March 21, 1908. Battery and coil system.

1,165,602. Automatic Replacing Device for Circuit-Breakers; G. S. Hoover, Tippecanoe, Ohio. App. filed April 4, 1914. Operates as soon as abnormal condition is removed.

1,165,610. Timing Device for Explosion Engines; F. H. Landsdell, Atlanta, Ga. App. filed Dec. 31, 1914. Designed for Ford engines.

1,165,619. Electrode for Projection Apparatus; M. H. Moffett, Lakewood, Ohio. App. filed Oct. 1, 1913. Insulation for ends of electrodes.

1,165,639. Electropneumatic Brake Apparatus; W. V. Turner, Edgewood, Pa. App. filed July 10, 1914. Electromagnetic vent valve.

1,165,663. Controller; H. E. Goldberg, Chicago, Ill. App. filed Jan. 10, 1911. Control sheet for electric signs, etc. Sixty-three claims.

1,165,683. Electric Switch Mechanism; J. B. Lee, Savannah, Ga. App. filed March 21, 1911. For simultaneously making or breaking a plurality of circuits.

1,165,690. Telephone-Exchange Trunking System; T. G. Martin, Chicago, Ill. App. filed Dec. 10, 1910. Semi-automatic, with two-way trunk lines.

1,165,709. Automatic Telephone System; W. T. Powell, Chicago, Ill. App. filed Nov. 28, 1913. Prevents trunk lines being unnecessarily tied up after a connection has been released.

1,165,728. Telephone Trunking System; J. A. Taggart, Rochester, N. Y. App. filed May 1, 1915. Increased speed of distribution of trunked calls.

1,165,745. Electrical Measuring Instrument; A. O. Benecke, Foxboro, Mass. App. filed Feb. 14, 1912. Permanent magnet-moving coil type.

1,165,747. Coupling for Conduit Rods; E. L. Brockway, Glenside, Pa. App. filed Jan. 7, 1915. Enables coupling of rods at any angle.

Record of Electrical Patents

Notes on United States Patents issued Dec. 28, 1915, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,165,756. Cable Terminal; F. B. Cook, Chicago, Ill. App. filed Feb. 25, 1910. Terminal head for holding wires of cable in distribution.

1,165,788. Means for Regulating the Speed of Electric Motors; F. G. Liljenroth, Vesteras, Sweden. App. filed Dec. 21, 1914. More perfect speed regulation.

1,165,843. Removable Unit Oil Switch; G. A. Burnham, Cliftondale, Mass. App. filed Feb. 8, 1911. Protects operator from danger.

1,165,844. Protecting Means for Electrical Distribution Systems; G. A. Burnham, Saugus, Mass. App. filed Nov. 27, 1911. Protecting circuit extends throughout.

1,165,850. Frequency Meter for Measuring Electrical Current; L. Cohen, Brant Rock, Mass. App. filed Sept. 20, 1910. Continuous and direct indication of current and frequency.

1,165,853. Signal-Lamp Control for Vehicles; C. W. Davis, Chicago, Ill. App. filed March 28, 1914. Rear lamp cannot be extinguished without dismounting from the vehicle.

1,165,862. Apparatus for Wireless Signaling; R. A. Fessenden, Brant Rock, Mass. App. filed Sept. 16, 1907. Production of high-frequency oscillations.

1,165,903. Playing Apparatus for Musical Instruments; W. C. Reed, Dalton, Mass. App. filed Jan. 29, 1913. "Telectric" construction.

1,165,904. Electromagnet; W. C. Reed, Dalton, Mass. App. filed Feb. 12, 1913. For electric piano-players.

1,165,916. Safety Elevator Device; I. Spiradek, S. Kalisz and W. Wilkosz, Chicago, Ill. App. filed June 8, 1914. Door-controlled switches.

1,165,928. Power-Factor Regulator; F. H. Winter, Schenectady, N. Y. App. filed Aug. 4, 1913. Regulation of field excitation.

1,165,943. Electrically Controlled Lock; L. Cadenel, Paris, France. App. filed March 12, 1914. Keyless combination.

1,165,949. Direction Indicator for Motor Vehicles; S. F. Douglass, Prairie du Rocher, Ill. App. filed May 21, 1915. Controlled from steering wheel.

1,165,958. Heating System for Constant-Temperature Baths; T. B. Freas, New York, N. Y. App. filed March 17, 1913. Maintains temperature accurately, irrespective of room temperature.

1,165,983. Electrolytic Rectifier; A. LeBlanc, New York, N. Y. App. filed April 12, 1913. Simple and inexpensive construction.

1,166,030. Controlling Mechanism for Electric-Light Signs; W. A. Willower, C. W. Angell and J. W. Gallaspie, Lima, Ohio. App. filed Aug 20, 1913. Perforated control sheet.

1,166,034. Electrical Apparatus for Transmitting Signals; W. Akemann, Essen-on-the-Ruhr, Germany. App. filed March 9, 1915. Transmitter and receiver with a reading device.

1,166,055. Electric Switch; J. A. Keyes, New York, N. Y. App. filed March 21, 1912. Actuated by a door.

1,166,069. Regulating Device for Regenerative Furnaces; C. H. Macmillan, Limerick, Me. App. filed April 14, 1915. Employs heat-responsive devices.

1,166,075. Clutch Mechanism for Transmitting Motion; M. P. Otto, Paris, France. App. filed Nov. 18, 1913. Remote control for steering torpedoes.

1,166,081. Thermostat; J. H. Royall, Houston, Tex. App. filed Aug. 3, 1914. Positive and automatic action.

1,166,087. Electric Coupling; A Schmidt, Flint, Mich. App. filed Nov. 6, 1912. Clip for attaching wires to a spark plug.

1,166,090. Indicating System for Telephone Pay Stations; A. J. Seymour, Minneapolis, Minn. App. filed Nov. 1, 1910. Indicates denomination of coin deposited.

1,166,095. Electric Heating Element; H. E. Van Doren, South Bend, Ind. App. filed March 7, 1914. Utilizes high-resistance elements.

1,166,101. Storage Battery; T. A. Willard, Cleveland, Ohio. App. filed July 6, 1915. Terminal posts shaped to enable use of narrow cells.

1,166,102. Storage Battery; T. A. Willard, Cleveland, Ohio. App. filed Aug. 9, 1915. Vent plug.

1,166,108. Spark Plug; C. K. Austin, Woodstock, Ill. App. filed Jan. 16, 1914. Plurality of removable electrodes.

1,166,149. Binding Device for Panelboards; R. H. Olley, Syracuse, N. Y. App. filed Nov. 30, 1914. Built of a plurality of rings.

1,166,150. Voltage Regulator; A. H. Olmsted, Altrincham, Eng. App. filed Nov. 18, 1914. For varying the excitation.

1,166,152. Telephone Receiver; T. Rhodus, Chicago, Ill. App. filed Feb. 15, 1915. For head set.

1,166,154. Sadiron; E. E. Rose, Swissvale, Pa. App. filed June 28, 1911. May be electrically disconnected without severing mechanical connections.

1,166,157. Liquid Rheostat; K. A. Simmon and A. J. Hall, Wilkinsburg, Pa. App. filed June 20, 1914. System for supplying electrolyte.

1,166,159. Method of Measuring Capacity and Power-Factor; P. Thomas, Wilkinsburg, Pa. App. filed Dec. 4, 1913. Simultaneously measures capacity and power-factor.

1,166,161. Brush-Holder; M. Walker, Hale, Eng. App filed Jan 17, 1912. Brushes always maintained at same angle.

1,166,186. Starting Means for Vapor-Electric Devices; F. Conrad, Swissvale, Pa. App. filed Jan. 7, 1911. Operated from exterior of rectifier casing.

1,166,194. Automatic Electric Coupling Mechanism for Car-Line Circuits; J. S. Doyle, Yonkers, and F. Hedley, Mount Vernon, N. Y. App. filed Jan. 27, 1912. Protected from dirt, etc.

1,166,196. Vapor Rectifier; G. M. Eaton, Pittsburgh, Pa. App. filed March 30, 1914. Supports for the shielding members between the anodes.

1,166,229. Regulator; H. A. Laycock, Schenectady, N. Y. App. filed Oct. 7, 1912. Resistance type.

1,166,331. Method and Apparatus for Safeguarding Navigation; A. G. Davis, Schenectady, N. Y. App. filed Dec. 4, 1911. Iceberg detection.

1,166,339. Electromagnetic Switch; J. Eaton, Schenectady, N. Y. App. filed Aug. 4, 1913. Contacts prevented from "freezing."

1,166,345. Switch Handle; F. P. Gates, Hartford, Conn. App. filed May 24, 1915. Porcelain; for rotary snap switches.

1,166,349. Attachment Plug and Receptacle; G. W. Goodridge, Bridgeport, Conn. App. filed Jan. 2, 1912. Flush type.

1,166,366. Sparking Indicator; C. E. Harlan, Watsonville, Cal. App. filed Dec. 9, 1914. Portable testing set for gas engines.

1,166,375. Apparatus for Refining Petroleum; R. G. Jones, Los Angeles, Cal. App. filed Dec. 11, 1913. Oil in any given retort of substantially uniform temperature throughout.

1,166,385. Spark Plug; D. W. Peck, Syracuse, N. Y. App. filed Jan. 10, 1912. Has hollow central electrode

1,166,391. Insulator; L. Steinberger, Brooklyn, N. Y. App. filed March 14, 1911. Disk strain insulator.

1,166,392. Insulator; L. Steinberger, Brooklyn, N. Y. App. filed Feb. 10, 1912. High potential; great strength.

1,166,393. Insulator; L. Steinberger, Brooklyn, N. Y. App. filed July 25, 1912. Protected against lightning.

1,166,394. Spool-Type Disk-Strain Insulator; L. Steinberger, Brooklyn, N. Y. App. filed Aug. 7, 1912. Vertical column concatenated units.

1,166,407. Air-Brake Hose Coupling; W. O. Benn, McAdam Junction, New Brunswick, Canada. App. filed Dec. 12, 1914. Complete and electric circuit.

1,166,410. Electrical Instrument; G. W. W. Cornman, Philadelphia, Pa. App. filed May 12, 1914. Improved means for correlating the several parts.

1,166,414. Galvanic Cell; M. L. Kaplan, Brooklyn, N. Y. App. filed May 1, 1915. Acid, manganous, polymanganite, depolarizing.